

**Ministry of Education
Department of Higher Education
East Yangon University**

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Research Journal**

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Research Journal 2023, Vol. 9, No. 1

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CONTENTS

No	Title	Page
1.	“မြန်မာကြိယာပေါင်းတို့၏ ဖွဲ့စည်းမှုနှင့် အနက်အဓိပ္ပာယ်” ဆက်စပ်ပုံ ဒေါက်တာအေးအေးမွန် ၊ ပါမောက္ခ ၊ မြန်မာစာဌာန	1
2.	မြန်မာနိုင်ငံတွင် ခေါင်းလောင်းများ စတင်သွန်းလုပ်လာခြင်းနှင့် ခေါင်းလောင်းစာများ စတင် ရေးထိုးလာခြင်း ဒေါက်တာနီနီအောင်၊ တွဲဖက်ပါမောက္ခ ၊ မြန်မာစာဌာန	12
3.	ကြေးမုံနှင့် မြန်မာ့အလင်းသတင်းစာများ သတင်းခေါင်းစီး ဒေါ်ခင်နှင်းရီ၊ ညွှန်ကြားရေးမှူး၊ ကျောင်းပြင်ပနှင့်တသက်တာပညာရေးဦးစီးဌာန	28
4.	AN ANALYSIS ON THE ERRORS OF SECOND YEAR ENGLISH SPECIALIZATION STUDENTS IN THE USE OF ADJECTIVES <i>Daw Yee Yee Aung, lecture, Department of English</i>	39
5.	A STUDY OF THE POETIC COMPARISON AND THE STRUCTURE OF WORDS WORTH'S POEMS <i>Daw Aye Aye Mar lecturer, Department of English</i>	46
6.	SPATIAL ANALYSIS ON FOOD SHOPS IN THONEGWA TOWN <i>Dr.Thitar Win, Professor, Department of Geography</i>	54
7.	A GEOGRAPHICAL ANALYSIS OF URBAN LANDUSE IN THINGANGYUN TOWNSHIP <i>Daw Htet Htet Aung, Tutor, Department of Geography</i>	62
8.	A GEOGRAPHICAL STUDY ON DOMESTIC USE OF WATER IN KYAUKTAN TOWN <i>Daw Yadanar Chan Myae Nyein, Tutor, Department of Geography</i>	68
9.	GEOGRAPHICAL ASSESSMENT ON SOIL DEGRADATION IN THANLYIN TOWNSHIP <i>Daw Su Myat Hay Mar Thein, Tutor, Department of Geography</i>	79
10.	GEOGRAPHICAL STUDY ON DEMOGRAPHY OF KHAYAN TOWNSHIP <i>Daw Khin Khin Win, Tutor, Department of Geography</i>	89
11.	AGRICULTURAL LIFE AND LIFE-STYLE DURING THE BAGAN PERIOD (A.D.1100-1250) <i>Dr. Ko Ko Toe Lwin Thaw, Associate Professor, Department of History</i>	101
12.	AN ETHICAL ANALYSIS OF THE LOKANITI <i>Dr. Tin Tin Sein, Professor, Department of Philosophy</i>	116

No	Title	Page
13.	A STUDY ON THE RELATIONSHIP BETWEEN LOCUS OF CONTROL AND LEARNING PERFORMANCE OF UNIVERSITY STUDENTS <i>Dr. Htar Htar Khin, Professor(Head), Department of Psychology</i>	120
14.	RIGHTS OF CHILD OFFENDER IN MYANMAR <i>Daw Zun Yupar Myint, Lecturer, Department of law</i>	130
15.	THE ROLE OF MYANMAR IN COMMIT DURING 2004-2018 <i>Dr. Htay Htay Nyein, Professor and Head, Department of International Relations</i>	138
16.	COMPARATIVE STUDY OF CATALASE ENZYME ACTIVITY IN EIGHT VEGETABLE SAMPLES <i>Daw Tin Zar Ni Tun, Lecture, Department of Chemistry</i>	147
17.	STUDIES ON THE EFFECT OF RIPENING AGENT UPON BANANA SAMPLES (Phee-Gyan and Thee-Hmwe) <i>Dr. Aye Thandar Win, Demonstrator, Department of Chemistry</i>	157
18.	INVESTIGATION ON PHYTOCHEMICALS, ANTIOXIDANT ACTIVITY AND TOTAL PHENOL CONTENT OF <i>ADIANTUM CAPILLUS-VENERIS</i> L. (MAIDENHAIR FERN) <i>Daw Myint Sandi Kyaw, Demonstrator, Department of Chemistry</i>	167
19.	ENZYMATIC PROPERTIES OF α - AMYLASE FROM <i>VIGNA RADIATA</i> L. (PE-TE-SEIN) <i>Daw Shoon Leii Khin, Demonstrator, Department of Chemistry</i>	176
20.	REMOVAL OF METHYLENE BLUE SOLUTION BY USING STEM AND PEEL CHAR OF BANANA <i>Daw Sandar Win, Demonstrator, Department of Chemistry</i>	186
21.	ISOLATION AND CHARACTERIZATION OF PAPAIN FROM LATEX OF PAPAYA (<i>CARICA PAPAYAL</i> L.) <i>Daw Khin Yadanar Ko Ko, Demonstrator, Department of Chemistry</i>	196
22.	SCREENING OF PHYTOCHEMICALS AND SOME BIOACTIVITIES OF <i>KIGELIA AFRICANA</i> (LAM.) BENTH. FRUITS (SAUSAGE TREE) <i>Daw Pan Ei San, Demonstrator, Department of Chemistry</i>	205
23.	INVESTIGATION OF CALCIUM IN MILK SAMPLE BY SPECTROPHOTOMETRIC METHOD BY USING ARSENAZO III REAGENT <i>U Ye Yint Naing, Demonstrator, Department of Chemistry</i>	216

No	Title	Page
24.	DETERMINATION OF FERROUS ION CHELATING ACTIVITY OF <i>HYLOCEREUS UNDATUS</i> (DRAGON FRUIT) AND <i>CARICA PAPAYA</i> LINN. (PAPAYA FRUIT) <i>Daw Thet Thet Swe, Demonstrator, Department of Chemistry</i>	224
25.	INVESTIGATION ON PHYTOCHEMICAL CONSTITUENTS, NUTRITIONAL VALUES AND ELEMENTAL ANALYSIS OF NEEM (<i>AZADIRACHTA INDICA</i> A.JUSS) AND FERMENTED NEEM LEAVES <i>Daw Theingi Lwin , Demonstrator, Department of Chemistry</i>	232
26.	INVESTIGATION OF PHYTOCHEMICAL CONSTITUENTS AND CHARACTERIZATION OF ESSENTIAL OIL FROM <i>CURCUMA CAESIA</i> ROXB. (GA MONE TAIN PYAR) <i>Daw Theingi Wint Thu, Demonstrator, Department of Chemistry</i>	241
27.	INVESTIGATION ON SOME PHYTOCHEMICAL CONSTITUENTS AND ANTIMICROBIAL ACTIVITY OF LEAVES OF <i>PHYSALIS PERUVIANA</i> - L (HPAUNG-HPAUNG-THI) <i>U Thein Htet Aung, Demonstrator, Department of Chemistry</i>	251

မြန်မာကြိယာပေါင်းတို့၏ ဖွဲ့စည်းမှုနှင့်အနက်အဓိပ္ပာယ်ဆက်စပ်ပုံ

အေးအေးမွန်*

စာတမ်းအကျဉ်း

ဤစာတမ်းသည် မြန်မာဘာသာစကားရှိ ကြိယာအချို့ကို ဘာသာဗေဒရှုထောင့်မှ လေ့လာထားသော စာတမ်းဖြစ်ပါသည်။ မြန်မာလုံးချင်းကြိယာများကို ပေါင်းစပ်ထားသော ကြိယာပေါင်းတို့တွင် လုံးချင်း ကြိယာတို့ကို ရှေ့နောက်ဖွဲ့စည်းမှုပြောင်းလဲပါက အနက်အဓိပ္ပာယ်ပြောင်းမပြောင်းကို လေ့လာထားခြင်း ဖြစ်သည်။ မြန်မာကြိယာ စကားလုံးများ၏ ဖွဲ့စည်းပုံနှင့် အနက်အဓိပ္ပာယ် ဆက်သွယ်ပုံကို သိရှိလိုသော ရည်ရွယ်ချက်ဖြင့် လေ့လာထားခြင်းဖြစ်ပြီး မြန်မာဘာသာစကားရှိ ကြိယာတို့ကို စိတ်ဝင်စားသူများ အတွက် ဗဟုသုတ ရရှိစေမည့် စာတမ်းတစ်စောင်ဟု ယူဆပါသည်။

သော့ချက်ဝေါဟာရ ။ ။ မြန်မာဘာသာစကား၊ လုံးချင်းကြိယာ၊ ကြိယာပေါင်း၊ ဖွဲ့စည်းမှု၊ အနက်အဓိပ္ပာယ်

နိဒါန်း

ဤစာတမ်းသည် မြန်မာဘာသာစကားရှိ ကြိယာများကိုအခြေခံ၍ လေ့လာထားသော ဘာသာဗေဒဆိုင်ရာ စာတမ်းဖြစ်ပါသည်။ မြန်မာလူမျိုးတို့ နေ့စဉ် ပြောဆို ရေးသား သုံးနှုန်းနေသော ကြိယာစကားလုံး များကို အခြေခံ၍ အလေ့လာခံ ကြိယာစကားလုံးများကို ရွေးချယ်ထားပါသည်။ မြန်မာဘာသာစကားသည် ဧကဝဏ္ဏ ဘာသာစကားဖြစ်ပြီး ကြိယာတို့တွင် လုံးချင်းကြိယာ၊ ထိုလုံးချင်းကြိယာတို့ကို ပေါင်းစပ်ထားသော ကြိယာပေါင်း ဟူ၍ရှိပါသည်။

လုံးချင်းကြိယာတို့ကို ပေါင်းစပ်၍ သုံးနှုန်းသော ကြိယာပေါင်းတို့ကို လေ့လာရာတွင် မူလလုံးချင်း ကြိယာ၏အနက်နှင့် ကြိယာတို့ကို ပေါင်းစပ်သောအခါ ဖြစ်ပေါ်လာသော အနက်မှာ တူသည်လည်းရှိပြီး၊ ကြိယာပေါင်းတွင်ပါဝင်သောလုံးချင်းကြိယာတို့ကို ရှေ့နောက် ပြောင်း၍ ပေါင်းစပ်ပါက ထိုကြိယာတို့၏ အနက်မှာ မူလအနက်နှင့် တူသည်ကိုလည်းကောင်း၊ အနက်လျော့သည်ကိုလည်းကောင်း၊ အနက် ပြောင်းသည်ကိုလည်းကောင်း အနက်ကျယ်ပြန့် လာသည်ကိုလည်းကောင်း တွေ့ရပါသည်။ ကြိယာနှစ်လုံး ပေါင်းစပ်ရာတွင် အနက်ပြောင်းလဲမှု မရှိသော ပေါင်းစပ်ခြင်းသည် အပြိုင်ပေါင်းခြင်းဖြစ်ပြီး၊ အနက်လျော့ခြင်း၊ အနက်ပြောင်းခြင်း၊ အနက်ကျယ်ပြန့်ခြင်း ဖြစ်ပါက ကြိယာ တစ်လုံးလုံးက ဦးဆောင်နေသော ပေါင်းစပ်ခြင်း ဖြစ်ပါသည်။

မြန်မာကြိယာ စကားလုံးများကို နေ့စဉ်ပြောဆိုရေးသား သုံးစွဲနေကြသော်လည်း တချို့မှာ အနက်အဓိပ္ပာယ် လွဲမှားစွာသုံးစွဲနေမှု၊ အနက်ကို ခြေခြေမြစ်မြစ် မသိဘဲ သုံးစွဲနေမှုရှိသည်ကို တွေ့ရပါသည်။ ကြိယာတို့ကို လေ့လာရာတွင် ဘာသာဗေဒရှုထောင့်မှ လေ့လာထားပြီး ကြိယာပေါင်းတို့၏ ဖွဲ့စည်းမှုအရ အနက်အဓိပ္ပာယ် မည်သို့ရှိသည်ကို သိရှိဗဟုသုတရရှိစေနိုင်မည်ဟု ယူဆပါသည်။

*ဒေါက်တာ၊ ပါမောက္ခ၊ မြန်မာစာဌာန၊ ရန်ကုန်အရှေ့ပိုင်းတက္ကသိုလ်

၁။ ဘာသာဗေဒ

ဘာသာဗေဒဆိုသည်မှာဘာသာစကားများကိုသိပ္ပံနည်းကျလေ့လာသောပညာရပ်ဖြစ်ပါသည်။ ဘာသာစကားများကို သိပ္ပံနည်းကျလေ့လာရာတွင် ဖွဲ့စည်းမှုနှင့် အနက်အဓိပ္ပာယ် ဟူသည့်လက္ခဏာရပ် နှစ်ခုဖြင့် လေ့လာကြပါသည်။

ဘာသာဗေဒရှုထောင့်မှ လေ့လာရာတွင် ...

(၁) သရုပ်ဖော်ဘာသာဗေဒ

(Descriptive Linguistics)

(၂) အနှိုင်းဘာသာဗေဒ

(Comparative Linguistics)

(၃) သမိုင်းဘာသာဗေဒ

(Historical linguistics)-----စသည့် ဘာသာဗေဒရှုထောင့်များမှ လေ့လာကြပါသည်။

ဤစာတမ်းတွင် မြန်မာကြိယာပေါင်းများ၏အနက်ကို လေ့လာရာတွင် သရုပ်ဖော် ဘာသာဗေဒ ရှုထောင့်မှလေ့လာမည် ဖြစ်ပါသည်။

သရုပ်ဖော်ဘာသာဗေဒဆိုသည်မှာ ‘အချိန်ကာလတစ်ခုအတွင်း ဘာသာစကားတစ်ခု၏ အစိတ်အပိုင်းများ ပြောင်းလဲမှုကို အသေးစိတ်သရုပ်ဖော် လေ့လာသော ပညာရပ်ဖြစ်သည်’(David Crystal-132-133)ဟု ဖွင့်ဆိုထားသည်။

သရုပ်ဖော်ဘာသာဗေဒတွင် ‘စကားလုံးအစိတ်အပိုင်း အတွဲအဖွဲ့တို့ကို လေ့လာချက် (သဒ္ဒါ)နှင့် အဓိပ္ပာယ်လေ့လာချက် ဟူ၍ နှစ်ပိုင်းခွဲနိုင်သည်’ (ဒေါ်ခင်ခင်အေး-စာ ၁၅၆)ဟု ဆိုပါသည်။

မြန်မာကြိယာပေါင်းတို့ကို လေ့လာရာတွင် သရုပ်ဖော်ဘာသာဗေဒရှုထောင့်မှ လေ့လာမည် ဖြစ်ပါသည်။ လုံးချင်းကြိယာတို့ကို ပေါင်းစပ်ထားသော ကြိယာပေါင်းတို့တွင် လုံးချင်းကြိယာ တို့ကိုဖွဲ့စည်းပုံ ရှေ့နောက် ပြောင်းပြန် ထား၍ပေါင်းစပ်ပါက ဖြစ်ပေါ်လာသော ကြိယာပေါင်းတို့၏ အနက်ပြောင်း/ မပြောင်း၊ ကျယ်ပြန့်မှု ရှိ/မရှိကို လေ့လာမည်ဖြစ်ပါသည်။

၂။ ကြိယာပေါင်းတို့၏ ဖွဲ့စည်းမှုနှင့်အနက်အဓိပ္ပာယ် လေ့လာချက်

ကြိယာပေါင်းများကို လေ့လာရာတွင် လုံးချင်းကြိယာများ၏ မူလအနက်နှင့် ကြိယာတို့ကို ပေါင်းစပ် သောအခါဖြစ်ပေါ်လာသည့် ကြိယာပေါင်းတို့၏အနက်ကို ဆန်းစစ် လေ့လာမည် ဖြစ်ပါသည်။ ကြိယာပေါင်း တို့တွင်ပါဝင်သော လုံးချင်းကြိယာတို့ ဖွဲ့စည်းပုံ ပြောင်းသောအခါ ဖြစ်ပေါ်လာသည့် အနက်အဓိပ္ပာယ်ကို အခြေခံ၍ အနက်တူသော ကြိယာများ၊ အနက်ပြောင်းသော ကြိယာများအနက်လျော့သွားသောကြိယာများ၊ အနက်ကျယ်ပြန့်လာသော ကြိယာများ၊ စာပေသုံး ကြိယာများ ဟူ၍ ခွဲခြားလေ့လာမည် ဖြစ်ပါသည်။ ကြိယာတို့၏အနက် ပြောင်းလဲသည်ဆိုရာတွင် လုံးဝမတူညီ တော့သော ပြောင်းလဲခြင်းမဟုတ်ဘဲ အနက်သစ်တစ်ခုရှိသော ပြောင်းလဲခြင်းကို ဆိုလို ပါသည်။

၂။ ၁။ အပြိုင်ပေါင်းသောကြိယာပေါင်းများ

လုံးချင်းကြိယာတို့ကို ပေါင်းစပ်ရာတွင် လုံးချင်းကြိယာတို့ကို ရှေ့နောက်ပြောင်းပြန်ထား၍ ပေါင်းစပ် သော တချို့ ကြိယာပေါင်းတို့သည် အနက်မပြောင်းသည်ကို တွေ့ရသည်။

ကင်းလွတ် နှင့် လွတ်ကင်း

$$\begin{array}{rclcl} v & + & v & = & \text{cpd.v.} \\ \text{ကင်း} & + & \text{လွတ်} & = & \text{ကင်းလွတ်} \\ \text{လွတ်} & + & \text{ကင်း} & = & \text{လွတ်ကင်း} \end{array}$$

ကင်းလွတ် နှင့် လွတ်ကင်း ဟူသောကြိယာပေါင်းသည် ကင်း နှင့် လွတ် ဟူသော လုံးချင်း ကြိယာတို့ကို ပေါင်းစပ် ထားသောကြိယာပေါင်းဖြစ်သည်။ ကင်း ၏ အနက်မှာ ‘ မရှိ၊ အန္တရာယ် ကင်းသည်၊ အဆက်အဆံ မရှိ၊ အတူတကွမဟုတ် ’ (မြန်မာအဘိဓာန်-၁၅) စသည့် အနက်များ ရှိသည်။

လွတ် ၏ အနက်မှာ ‘ တစ်စုံတစ်ရာမရှိ၊ ကင်းမဲ့သည်၊ လပ်သည်၊ ချုပ်ချယ်မှု ငြိတွယ်မှု စသည်တို့မှ ကင်းသည်’ (မြန်မာအဘိဓာန်-၃၄၈) စသည့် အနက်များရှိသည်။

ကြိယာပေါင်းဖြစ်သော ကင်းလွတ် နှင့် လွတ်ကင်း တို့၏ အနက်မှာ ချုပ်နှောင်မှု တစ်စုံတစ်ရာမရှိ၊ လွတ်လပ်သည်ဟူသည့် အနက်ရှိသည်။ ကြိယာပေါင်း နှစ်ခုစလုံးတွင် ပါဝင်သော လုံးချင်း ကြိယာများသည် အနက်တူသည့်အတွက် အပြိုင်ပေါင်းစပ်ကြသည်ကို သိနိုင်သည်။

ထို့ကြောင့် ဖော်ပြပါ ကြိယာပေါင်းတွင်ပါရှိသည့် လုံးချင်းကြိယာတို့ကို ဖွဲ့စည်းပုံ ရှေ့နောက် ပြောင်းသော်လည်း အနက်မပြောင်းကြောင်း တွေ့ရ သည်။

ကိုင်းစွဲနှင့်စွဲကိုင်း

$$\begin{array}{rclcl} v & + & v & = & \text{cpd.v.} \\ \text{ကိုင်း} & + & \text{စွဲ} & = & \text{ကိုင်းစွဲ} \\ \text{စွဲ} & + & \text{ကိုင်း} & = & \text{စွဲကိုင်း} \end{array}$$

ကိုင်းစွဲ နှင့် စွဲကိုင်း ဟူသော ကြိယာပေါင်းတို့သည် ကိုင်း နှင့် စွဲ ဟူသော လုံးချင်းကြိယာတို့ကို ပေါင်းစပ် ထားသော ကြိယာပေါင်း ဖြစ်သည်။

ကိုင်း ၏ အနက်မှာ ‘လက်ဖြင့်ဆုပ်သည်၊ လက်၌ထားသည်’ (မြန်မာအဘိဓာန်-၁၆) စသည့် အနက်များရှိသည်။

စွဲ ၏ အနက်မှာ ‘မြဲမြံစွာတည်နေသည်၊ ကိုင်ဆောင်သည်’ (မြန်မာအဘိဓာန်-၁၁၅) စသည့် အနက်များရှိသည်။

ကြိယာပေါင်းဖြစ်သော ကိုင်းစွဲနှင့်စွဲကိုင်းတို့၏ အနက်သည် မူလလုံးချင်းကြိယာတို့၏ အနက်အရ ‘လက်ထဲတွင် မြဲမြံစွာဆုပ်ကိုင်ထားသည်’ ဟူသော အနက်ရှိသည်။

သို့သော် ကိုင်းစွဲနှင့် စွဲကိုင်းတို့၏ အနက်မှာ မူလ အနက်ထက်ပို၍ အနက်ကျယ်ပြန့်နေသည်။ မူလ လုံးချင်းစကားလုံးတို့၏ အနက်မှာ လက်ထဲတွင် မြဲမြံစွာဆုပ်ကိုင် ထားသည့်အနက် ဖြစ်သော်လည်း အကြောင်းတစ်စုံတစ်ရာကို ‘စိတ်ထဲတွင် စွဲမြဲစွာ မှတ်သားယုံကြည်

ထားသည်'ဆိုသည့် အနက်ဖြင့်သုံးနှုန်း ကြသည်ကို တွေ့ရသည်။ ကြိယာပေါင်းနှစ်ခု စလုံးတွင် ပါဝင်သော လုံးချင်းကြိယာများသည်အပြိုင်ပေါင်းစပ်ကြပြီး အနက်ပို၍ ကျယ်ပြန့် လာသည်။

ကိုင်ဆုပ်နှင့်ဆုပ်ကိုင်

v	+	v	=	cpd.v.
ကိုင်	+	ဆုပ်	=	ကိုင်ဆုပ်
ဆုပ်	+	ကိုင်	=	ဆုပ်ကိုင်

ကိုင်ဆုပ် နှင့် ဆုပ်ကိုင် ဟူသော ကြိယာပေါင်းတို့သည် ကိုင် နှင့် ဆုပ် ဟူသော လုံးချင်း ကြိယာတို့ကို ပေါင်းစပ်ထားသော ကြိယာပေါင်း ဖြစ်သည်။

ကိုင် ၏အနက်မှာ 'လက်ဖြင့်ဆုပ်သည်၊လက်၌ထားသည်' (မြန်မာအဘိဓာန်-၁၆) စသည့် အနက်များ ရှိသည်။

ဆုပ် ၏ အနက်မှာ 'လက်ချောင်းများကို ကျစ်ကျစ်ခေါက်သည်၊ တစ်စုံတစ်ရာကို ကိုင်ဆုပ်သည်' (မြန်မာအဘိဓာန်-၁၂၅) ဟု အနက်ရှိသည်။

ကြိယာပေါင်းဖြစ်သော ကိုင်ဆုပ် ၏ အနက်မှာ 'လက်ထဲတွင်မြဲမြံစွာဆုပ်ကိုင်ထားသည်' ဟူသော အနက်ရှိသည်။

ဆုပ်ကိုင်၏ အနက်မှာလည်း 'လက်ထဲတွင် မြဲမြံစွာဆုပ်ကိုင်ထားသည်' ဟူသည့် အနက်ရှိသည်။ ကိုင်ဆုပ် နှင့် ဆုပ်ကိုင် တို့သည် ဖွဲ့စည်းပုံ ပြောင်းသော်လည်း အနက်မပြောင်းသော ကြိယာများ ဖြစ်သည်။ ကြိယာတို့ ပေါင်းစပ်ရာတွင် အပြိုင်ပေါင်းစပ်ကြသည်။

၂။ ၂။ ဦးဆောင်ကြိယာပြောင်းသောကြိယာပေါင်းများ

လုံးချင်းကြိယာတို့ကို ပေါင်းစပ်ရာတွင် ရှေ့နောက်ပြောင်းပြန်ထား၍ ပေါင်းသောအခါ တချို့ ကြိယာပေါင်း တို့တွင် ဦးဆောင်ကြိယာ ပြောင်းသည်ကို တွေ့ရသည်။ တချို့ကြိယာ ပေါင်းတို့တွင် အနက်ပြောင်းသည်ကို တွေ့ရပြီး အနက်ပြောင်းရာတွင် အနက်မတူဘဲ ပြောင်းခြင်း၊ အနက် လျော့သွားခြင်း ၊ တချို့ကြိယာတို့မှာ အဖြည့်ပုဒ်ဖြစ်ခြင်းတို့ကို တွေ့ရသည်။

ဖက်ပြေး နှင့် ပြေးဖက်

v	+	v	=	cpd.v.
ဖက်	+	ပြေး	=	ဖက်ပြေး
ပြေး	+	ဖက်	=	ပြေးဖက်

ဖက်ပြေး၊ ပြေးဖက် ဟူသော ကြိယာသည် ဖက် နှင့် ပြေး ဟူသော လုံးချင်းကြိယာတို့ကို ပေါင်းစပ် ထားသော ကြိယာပေါင်းဖြစ်သည်။

ဖက် ၏ အနက်မှာ ' သိမ်းကျုံးပိုက်ယူသည်၊ ယှဉ်တွဲသည် ' (မြန်မာအဘိဓာန်-၂၄၂) စသည့် အနက်များရှိသည်။

ပြေး၏အနက်မှာ 'အဟုန်ဖြင့်သွားသည်' (မြန်မာအဘိဓာန်-၂၃၄) ဟူသည့် အနက်ရှိသည်။

ကြိယာပေါင်းဖြစ်သော ဖက်ပြေး ၏ အနက်မှာ ‘လူတစ်ဦးနှင့်တစ်ဦး အတူတကွ ဖက်၍ ယှဉ်တွဲ၍ အရှိန်အဟုန်ဖြင့်သွားသည်’ ဟူသည့်အနက်ရှိသည်။ အနက်အဓိပ္ပာယ်အရ ကြိယာ နှစ်လုံးမှာ အပြိုင် ပေါင်းစပ်ကြောင်း သိနိုင်သည်။ ကြိယာပေါင်းဖြစ်သော ဖက်ပြေးတွင် ကြိယာ တစ်လုံးချင်း၏ မူလအနက် ပါဝင်နေပြီး ကြိယာနှစ်ခုမှာ အပြိုင်ပေါင်းစပ်ကြောင်း သိနိုင်သည်။

ပြေးဖက် ဟူသည့် ကြိယာပေါင်းမှာမူ ‘အရှိန်အဟုန်ဖြင့် ပြေးပြီးမှ တစ်စုံတစ်ဦးကို သိမ်းကျုံး ပိုက်ယူသည်၊ယှဉ်တွဲသည်’ ဆိုသောအနက်ရှိသည်။ အနက်အဓိပ္ပာယ်အရ ပြေး ကြိယာသည် ဦးဆောင် ကြိယာဖြစ်သည်။ ကြိယာပေါင်းဖြစ်သော ပြေးဖက် တွင် ကြိယာတစ်လုံးချင်း၏ မူလအနက်ပြောင်းလည်းခြင်း မရှိသော်လည်း ဦးဆောင်ကြိယာမှာ ပြေး ဖြစ်သည်။

ထို့ကြောင့် ဖော်ပြပါ လုံးချင်းကြိယာတို့ကို ဖွဲ့စည်းပုံ ရှေ့နောက်ပြောင်းသောအခါ ဦးဆောင် ကြိယာ ပြောင်းကြောင်းတွေ့ရသည်။

ပြေးကြည့် နှင့် ကြည့်ပြေး

$$\begin{array}{ccccccc} v & + & v & = & \text{cpd.v.} \\ \text{ပြေး} & + & \text{ကြည့်} & = & \text{ပြေးကြည့်} \\ \text{ကြည့်} & + & \text{ပြေး} & = & \text{ကြည့်ပြေး} \end{array}$$

ပြေးကြည့် ၊ ကြည့်ပြေး ဟူသော ကြိယာပေါင်းသည် ပြေး နှင့် ကြည့် ဟူသော လုံးချင်းကြိယာ တို့ကို ပေါင်းစပ်ထားသော ကြိယာပေါင်း ဖြစ်သည်။

ပြေး ၏ အနက်မှာ ‘အဟုန်ဖြင့်သွားသည်’ (မြန်မာအဘိဓာန်-၂၃၄) ဟူသောအနက်ရှိသည်။

ကြည့် ၏ အနက်မှာ ‘မျက်စိဖြင့်မြင်ရအောင်အား ထုတ်သည်၊ သတိပြုသည်’ (မြန်မာအဘိဓာန်-၃၉) စသည့် အနက်များ ရှိသည်။

ကြိယာပေါင်းဖြစ်သော ပြေးကြည့် ၏ အနက်မှာ တစ်နေရာရာသို့ အရှိန်အဟုန်ဖြင့်သွားပြီး မျက်စိဖြင့် မြင်ရအောင်အားထုတ်သည်ဟူသော အနက်ရှိသည်။ ပြေးကြည့် တွင် ပြေး သည် ဦးဆောင် ကြိယာ ဖြစ်သည်။

ကြည့်ပြေး ဟူသည့် ကြိယာမှာမူ ပြေး ကြိယာ လုပ်ဆောင်မှုအတွက် ‘အန္တရာယ်မဖြစ်စေရန် မျက်စိဖြင့်ကြည့်ပြီး၊ သတိပြုပြီးမှသာ အရှိန်အဟုန်ဖြင့် သွားသင့်သည်’ ဆိုသော အနက် ရှိသည်။ ကြည့်ပြေး တွင် ကြည့် သည် ဦးဆောင်ကြိယာ ဖြစ်သည်။

ထို့ကြောင့် ဖော်ပြပါ လုံးချင်းကြိယာတို့ကို ဖွဲ့စည်းပုံ ရှေ့နောက်ပြောင်းသောအခါ ဦးဆောင် ကြိယာ ပြောင်းကြောင်းတွေ့ရသည်။

ပြေးလိုက် နှင့် လိုက်ပြေး

$$\begin{array}{ccccccc} v & + & v & = & \text{cpd.v.} \\ \text{ပြေး} & + & \text{လိုက်} & = & \text{ပြေးလိုက်} \\ \text{လိုက်} & + & \text{ပြေး} & = & \text{လိုက်ပြေး} \end{array}$$

ပြေးလိုက် ၊ လိုက်ပြေး ဟူသော ကြိယာပေါင်းတို့သည် ပြေးနှင့်လိုက် ဟူသော လုံးချင်း ကြိယာတို့ကို ပေါင်းစပ်ထားသော ကြိယာပေါင်းဖြစ်သည်။

ပြေး ၏ အနက်မှာ ‘အဟုန်ဖြင့်သွားသည်’ (မြန်မာအဘိဓာန်-၂၃၄) ဟူသည့် အနက်ရှိသည်။

လိုက် ၏ အနက်မှာ ‘ တစ်ဦးသွားရာသို့ အခြားတစ်ဦးသွားသည်၊ အဖော်အဖြစ် အတူပါသွားသည်၊ အမိဖမ်းရန် နောက်မှ ပြေးသွားသည် ’ (မြန်မာအဘိဓာန်-၂၃၄) စသည့် အနက်များရှိသည်။

ကြိယာပေါင်းဖြစ်သော ပြေးလိုက် ၏ အနက်မှာ ‘တစ်ဦးသွားရာသို့ အခြားတစ်ဦးက အရှိန်ဟုန်ဖြင့် သွားသည်’ ဟူသည့် အနက်ရှိသည်။ ဤ လုံးချင်းကြိယာနှစ်လုံးတွင် ပြေး ကြိယာက ဦးဆောင်ကြိယာ ဖြစ်သည်။

လိုက်ပြေး ဟူသည့် ကြိယာကို ‘တစ်ဦးက အရှိန်အဟုန် ဖြင့်ပြေးပြီးမှ ကျန်တစ်ဦးက နောက်မှ သွားခြင်း’ ဟူသည့် အနက်ကိုယူပါက လိုက် ကြိယာသည် ရှေ့တွင်ရှိသော်လည်း ပြေး ကြိယာမှာ ဦးဆောင် ကြိယာ ဖြစ်သည်။

လိုက်ပြေး ဟူသည့်ကြိယာကို ‘ မိဘအုပ်ထိန်းသူမသိဘဲ မိမိချစ်သူနောက်သို့ လိုက်သွားသည် ’ (မြန်မာအဘိဓာန်-၃၄၀)ဟု ဖွင့်ဆိုထားသည်။ ထိုဖွင့်ဆိုချက်အရ တစ်ဦးနောက်သို့ ကျန်တစ်ဦးက နောက်မှ လိုက်သွားခြင်းဖြစ်၍ ဤအနက်တွင် လိုက် ကြိယာက ဦးဆောင်ကြိယာ ဖြစ်ကြောင်းတွေ့ရသည်။

တိုက်တွန်း နှင့် တွန်းတိုက်

$$\begin{array}{rclcl} v & + & v & = & \text{cpd.v.} \\ \text{တိုက်} & + & \text{တွန်း} & = & \text{တိုက်တွန်း} \\ \text{တွန်း} & + & \text{တိုက်} & = & \text{တွန်းတိုက်} \end{array}$$

တိုက်တွန်း၊ တွန်းတိုက်ဟူသော ကြိယာတို့သည် တိုက်နှင့်တွန်းဟူသော လုံးချင်းကြိယာတို့ကို ပေါင်းစပ်ထားသော ကြိယာပေါင်းများ ဖြစ်သည်။

တိုက် ၏ အနက်မှာ ‘ အရန်အဟုန်ဖြင့် ထိခတ်သည်၊ တိုးဝှေ့ရွှေ့ရှားသည်’ (မြန်မာအဘိဓာန်-၁၅၂) စသည့် အနက်များရှိသည်။

တွန်း ၏ အနက်မှာ ‘ အားဖြင့် ရွှေ့ရှားအောင် ပြုသည်’ (မြန်မာအဘိဓာန်-၁၆၄) စသည့် အနက်များ ရှိသည်။

ကြိယာပေါင်းဖြစ်သော တိုက်တွန်း ၏ အနက်မှာ ‘လူတစ်ဦးတစ်ယောက်အား တစ်စုံတစ်ရာ ပြုမူဆောင်ရွက်ရန် နှိုးဆော်သည်’ ဟူသည့် အနက်ရှိသည်။ လူတစ်ဦးတစ်ယောက်အား တစ်စုံတစ်ရာ ပြုမူဆောင်ရွက်ရန် နှုတ်ဖြင့် နှိုးဆော်ခြင်း၊ ပြောဆိုခြင်းဖြစ်သည်။ ထိုကြိယာပေါင်းရှိ လုံးချင်းကြိယာတို့၏ မူလအနက်မှာ ကိုယ်ဖြင့်ပြုလုပ်ရသော အပြုအမူကို ရည်ညွှန်းသည့်အနက်များ ဖြစ်သော်လည်း ကြိယာ ပေါင်း၏ အနက်မှာ စိတ်ကို ရည်ညွှန်းသော အနက်ဖြစ်သည်။ တိုက်တွန်း ဟူသည့် ကြိယာပေါင်းတွင် ဦးဆောင်ကြိယာ မရှိဘဲ အပြိုင်ပေါင်း များဖြစ်ပြီး အနက်မှာ ပြောင်းသွားသည်ကို တွေ့ရသည်။

တွန်းတိုက် ဟူသည့် ကြိယာမှာမူ တစ်စုံတစ်ရာ တစ်စုံတစ်ခု ရွှေ့ရှားအောင် အရှိန်အဟုန်ဖြင့်၊ အားဖြင့် လုပ်သည် ဟူသော အနက်ရှိသည်။ တစ်စုံတစ်ရာ တစ်စုံတစ်ခု ရွှေ့ရှားအောင် ပြုခြင်းဖြစ်သည်။ အရှိန်အဟုန်ဖြင့်၊ အားဖြင့် လုပ်ခြင်းဖြစ်ရာ အပြုအမူပါသည်ကို တွေ့ရသည်။ ထိုကြိယာပေါင်းသည်လည်း အပြိုင်ပေါင်းခြင်းဖြစ်ပြီး မူလ လုံးချင်းကြိယာအနက်ဖြင့်သာ သုံးနှုန်းကြသည်။

ဆိုက်ကပ် နှင့် ကပ်ဆိုက်

$$\begin{array}{rclcl} v & + & v & = & \text{cpd.v.} \\ \text{ဆိုက်} & + & \text{ကပ်} & = & \text{ဆိုက်ကပ်} \\ \text{ကပ်} & + & \text{ဆိုက်} & = & \text{ကပ်ဆိုက်} \end{array}$$

ဆိုက်ကပ်၊ ကပ်ဆိုက် ဟူသော ကြိယာတို့သည် ဆိုက်နှင့်ကပ် ဟူသော လုံးချင်းကြိယာတို့ကို ပေါင်းစပ်ထားသော ကြိယာပေါင်း ဖြစ်သည်။

ဆိုက်၏အနက်မှာ ‘ကျရောက်သည်၊ (ယာဉ်)ရောက်လာရပ်နားသည်’ (မြန်မာအဘိဓာန်-၁၂၂) စသည့် အနက်များရှိသည်။

ကပ် ၏ အနက်မှာ ‘နီးသည်၊ နီးစေသည်၊ ငြိတွယ်သည်၊ ငြိတွယ်စေသည်’ (မြန်မာအဘိဓာန်-၂၀) စသည့် အနက်များ ရှိသည်။

ကြိယာပေါင်းဖြစ်သော ဆိုက်ကပ် ၏ အနက်မှာ ‘ယာဉ်များ တစ်စုံတစ်ခုသောနေရာသို့ ရောက်ရှိ ရပ်နားသည်’ ဟူသည့် အနက် ရှိသည်။ ဆိုက်ကပ် ဟူသော ကြိယာပေါင်းတွင် ဆိုက် သည် ဦးဆောင် ကြိယာ ဖြစ်သည်။

ကပ်ဆိုက် ဟူသည့် ကြိယာပေါင်းကို လုံးချင်းကြိယာနှစ်လုံးပေါင်းစပ်သည့် ကြိယာပေါင်း အဖြစ် သုံးနှုန်းမှုမရှိဘဲ ကပ် ကို နာမ်အဖြစ်ယူပြီး ‘ကပ်ကြီးသုံးပါးဘေး ကျရောက်သည်’ ဆိုသော အနက်ဖြင့် သုံးနှုန်းကြသည်။ ထိုအနက်တွင် ကပ်သည် နာမ်ဖြစ်ပြီး ကပ်ဆိုက်သည် နာမ်ပေါင်းကြိယာ ဖြစ်သည်။

၂။ ၃။ အဆင့်လျော့သွားသောကြိယာပေါင်းများ

လုံးချင်းကြိယာတို့ ပေါင်းစပ်ရာတွင် မြန်မာဘာသာစကားရှိ လုံးချင်းကြိယာ တချို့သည် ကြိယာအဖြစ်သာမက ပစ္စည်းအဖြစ်လည်း အသုံးပြုနိုင်သည်။ ထို့ကြောင့် ကြိယာပေါင်းတွင် ကြိယာအဖြစ်မှ အဆင့် လျော့သွားသော ပေါင်းစပ်ခြင်းကိုလည်းတွေ့ရသည်။

သွားစား နှင့် စားသွား

$$\begin{array}{rclcl} v & + & v & = & \text{cpd.v.} \\ \text{သွား} & + & \text{စား} & = & \text{သွားစား} \\ \text{စား} & + & \text{သွား} & = & \text{စားသွား} \end{array}$$

သွားစား နှင့် စားသွား ဟူသော ကြိယာပေါင်းတို့သည် သွားနှင့်စား ဟူသော လုံးချင်းကြိယာတို့ကို ပေါင်းစပ်ထားသော ကြိယာပေါင်း ဖြစ်သည်။

သွား ၏ အနက်မှာ ‘ရွှေလျားသည်၊ ရွှေလျားအောင် ပြုသည်’ (မြန်မာအဘိဓာန်-၃၉၀) ဟူသည့် အနက်များ ရှိသည်။ ပစ္စည်းအဖြစ် သုံးနှုန်းပါက သွား ၏ အနက်မှာ ‘အတိတ်ကာလကို ဖော်ပြသော စကားလုံး’ (မြန်မာအဘိဓာန်-၃၉၀) ဖြစ်သည်။

စား ၏ အနက်မှာ ‘ဝါး၍မျိုသည်၊ မှီဝဲသုံးဆောင်သည်’ (မြန်မာအဘိဓာန်-၉၆) စသည့် အနက် များရှိသည်။ ပစ္စည်းအဖြစ် သုံးနှုန်းပါက စား ၏ အနက်မှာ ‘ကြိယာကို လေးနက်အောင် ထောက်ပံ့သော စကားလုံး’ (မြန်မာအဘိဓာန်-၉၆) ဖြစ်သည်။

သွား နှင့် စား ကြိယာစကားလုံးနှစ်လုံးသည် ပစ္စည်းအဖြစ်လည်း သုံးနှုန်းနိုင်သော စကားလုံး များ ဖြစ်သည်။

ကြိယာပေါင်းဖြစ်သော သွားစား ၏ အနက်မှာ ‘တစ်နေရာရာသို့ သွား၍ တစ်စုံတစ်ရာကို စားသည်’ ဟူသည့် အနက်ရှိသည်။ သွားစား ဟူသည့် ကြိယာပေါင်းတွင် သွား ကြိယာသည် ဦးဆောင် ကြိယာ ဖြစ်သည်။ စားသည် ပစ္စည်းစကားလုံး ဖြစ်သည်။

စားသွား ဟူသည့် ကြိယာမှာမူ ‘တစ်စုံတစ်ရာကို စား၍ ပြီးသွားပြီ’ဟူသောအနက်ရှိသည်။ စားသွားတွင် စားသည် ဦးဆောင်ကြိယာဖြစ်ပြီး သွား မှာ ပစ္စည်းစကားလုံး ဖြစ်သည်။

ပေးအပ် နှင့် အပ်ပေး

v	+	v	=	cpd.v.
ပေး	+	အပ်	=	ပေးအပ်
အပ်	+	ပေး	=	အပ်ပေး

ပေးအပ် နှင့် အပ်ပေး ဟူသော ကြိယာတို့သည် ပေး နှင့် အပ် ဟူသော လုံးချင်းကြိယာတို့ကို ပေါင်းစပ်ထားသော ကြိယာပေါင်း ဖြစ်သည်။

ပေး ၏ အနက်မှာ ‘အပ်နှင်းသည်၊ ရယူပိုင်ဆိုင်စေသည်’ (မြန်မာအဘိဓာန်-၂၁၆) စသည့် အနက်များရှိသည်။ ပစ္စည်းအဖြစ်သုံးပါက ပေး ၏ အနက်မှာ ‘သူတစ်ပါးအတွက် ဆောင်ရွက် သည့် သဘောကို ပြသော စကားလုံး’ (မြန်မာအဘိဓာန်-၂၁၆) စသည့် အနက်များရှိသည်။

အပ်၏အနက်မှာ ‘စောင်ရှောက် ထိန်းသိမ်းရန်ပေးသည်၊ လွှဲသည်’ (မြန်မာအဘိဓာန်-၄၄၃) စသည့် အနက်များရှိသည်။ ပစ္စည်းအဖြစ် သုံးပါက အပ် ၏ အနက်မှာ ‘သင့်တင့် လျောက်ပတ် ကြောင်း ပြသောစကားလုံး၊ ရိုသေလေးစားခြင်းသဘောဖြင့် ကြိယာ နောက်တွင် ဆက်သုံးသော စကားလုံး’ (မြန်မာအဘိဓာန်-၄၄၃) စသည့် အနက်များရှိသည်။

ကြိယာပေါင်းဖြစ်သော ပေးအပ် ၏ အနက်မှာ ‘တစ်စုံတစ်ရာကို တစ်ဦးတစ်ယောက်အား အပ်နှင်းလိုက်သည့်’ အနက်ရှိသည်။ ပေးအပ် တွင် ပေး သည် ဦးဆောင်ကြိယာ ဖြစ်သည်။ အပ် မှာ ပေး ကြိယာကို အထောက်အပံ့ပေးသော ပစ္စည်းဖြစ်သည်။ ရိုသေလေးစားခြင်းသဘောဖြင့် ကြိယာနောက်တွင် ဆက်သုံးသော စကားလုံး ဖြစ်သည်။

အပ်ပေး ဟူသည့် ကြိယာမှာမူ တစ်စုံတစ်ရာကို တစ်ဦးတစ်ယောက်ထံသို့ စောင်ရှောက် ထိန်းသိမ်းရန် ပေးသည်၊ လွှဲသည် ဟူသည့် အနက်ရှိသည်။ အပ်ပေးတွင် အပ် မှာ ဦးဆောင်ကြိယာ

ဖြစ်သည်။ ပေး မှာ ပစ္စည်း အဖြစ်သုံးနှုန်းသော စကားလုံးဖြစ်ပြီး ဦးဆောင်ကြိယာ၏ လုပ်ဆောင်ချက် ပြီးစီးပြီ ဟူသည့် အနက်ရှိသည်။

ဖော်ပြပါ ပေး နှင့် အပ် စကားလုံးနှစ်လုံးတို့သည် ပစ္စည်းအဖြစ်လည်း သုံးနှုန်းနိုင်သော စကားလုံးများဖြစ်သည်။ ကြိယာနှစ်လုံးစလုံးသည် ဦးဆောင်ကြိယာများအဖြစ်လည်းကောင်း၊ ပစ္စည်း အဖြစ်လည်းကောင်း တာဝန် နှစ်မျိုးလုံး ထမ်းဆောင်နိုင်သည်ကို သိရှိနိုင်သည်။ အပ်ပေး ကြိယာသည် အပြောတွင် သုံးနှုန်းသောကြိယာဖြစ်သည်။

ပေးဆပ် နှင့် ဆပ်ပေး

v + v = cpd.v.

ပေး + ဆပ် = ပေးဆပ်

ဆပ် + ပေး = ဆပ်ပေး

ပေးဆပ် နှင့် ဆပ်ပေး ဟူသောကြိယာတို့သည် ပေးနှင့်ဆပ် ဟူသော လုံးချင်းကြိယာတို့ကို ပေါင်းစပ်ထားသော ကြိယာပေါင်းဖြစ်သည်။

ပေး ၏ အနက်မှာ ‘ အပ်နှင်းသည်၊ ရယူပိုင်ဆိုင်စေသည် ’ (မြန်မာအဘိဓာန်-၂၁၆) စသည့် အနက်များရှိသည်။ ပစ္စည်းအဖြစ်သုံးပါက ပေး ၏ အနက်မှာ ‘ သူတစ်ပါးအတွက် ဆောင်ရွက်သည့် သဘောကို ပြသောစကားလုံး ’ (မြန်မာအဘိဓာန်-၂၁၆) ဟူသည့် အနက်ရှိသည်။

ဆပ် ၏ အနက်မှာ ‘(ကြွေး)ပြန်ပေးသည်၊ (ကျေးဇူး)တုံ့ပြန်သည်’ (မြန်မာအဘိဓာန်-၁၂၇) စသည့် အနက်များရှိသည်။

ကြိယာပေါင်းဖြစ်သော ပေးဆပ် ၏ အနက်မှာ ‘တစ်ဦးတစ်ယောက်အား ပေးအပ်ရန်ရှိသည့် တစ်စုံတစ်ရာကို အပ်နှင်းလိုက်သည့်’ ဟူသည့် အနက်ရှိသည်။ ပေးဆပ် တွင် ပေး နှင့် ဆပ် ကြိယာ နှစ်လုံးစလုံး ဦးဆောင်ကြိယာ ဖြစ်သည်။

ဆပ်ပေး ဟူသည့် ကြိယာပေါင်းမှာမူ ‘တစ်စုံတစ်ရာကို တစ်ဦးတစ်ယောက်ထံသို့ စောင်ရှောက် ထိန်းသိမ်းရန် ပေးသည်၊ လွှဲသည်’ ဟူသည့် အနက်ရှိသည်။ ဆပ်ပေးတွင် ဆပ် မှာ ဦးဆောင်ကြိယာ ဖြစ်သည်။ ပေး မှာ ပစ္စည်း အဖြစ်သုံးနှုန်းသော စကားလုံးဖြစ်ပြီး ဦးဆောင်ကြိယာ၏ လုပ်ဆောင်ချက် ပြီးစီးပြီ ဟူသည့် အနက်ရှိသည်။ ဆပ်ပေးကြိယာသည် အပြောတွင်သုံးနှုန်းသော ကြိယာ ဖြစ်သည်။

ပေးကမ်းနှင့် ကမ်းပေး

v + v = cpd.v.

ပေး + ကမ်း = ပေးကမ်း

ကမ်း + ပေး = ကမ်းပေး

ပေးကမ်း နှင့် ကမ်းပေး ဟူသော ကြိယာတို့သည် ပေးနှင့်ကမ်း ဟူသော လုံးချင်းကြိယာတို့ကို ပေါင်းစပ်ထားသော ကြိယာပေါင်း ဖြစ်သည်။

ပေး ၏ အနက်မှာ ‘ အပ်နှင်းသည်၊ ရယူပိုင်ဆိုင်စေသည် ’ (မြန်မာအဘိဓာန်-၂၁၆) စသည့် အနက်များ ရှိသည်။ ပစ္စည်းအဖြစ် သုံးပါက ပေး ၏အနက်မှာ ‘ သူတစ်ပါးအတွက် ဆောင်ရွက်သည့် သဘောကို ပြသော စကားလုံး ’ (မြန်မာအဘိဓာန်-၂၁၆) ဟူသည့် အနက်ရှိသည်။

ကမ်း ၏ အနက်မှာ ‘လှမ်းပေးသည်၊ ဝေငှသည်’ (မြန်မာအဘိဓာန်-၂၁) စသည့် အနက်ရှိသည်။

ကြိယာပေါင်းဖြစ်သော ပေးကမ်း ၏ အနက်မှာ ‘တစ်စုံတစ်ရာကို တစ်ဦး တစ်ယောက်ထံသို့ ရောက်ရှိအောင် အပ်နှင်းလိုက်သည်’ အနက်ရှိသည်။ ပေးကမ်း တွင် အနက်အဓိပ္ပာယ်အရကြည့်လျှင် ပေး ကြိယာသည် ဦးဆောင်ကြိယာ ဖြစ်သည်။ ပေး နှင့် ကမ်း တို့သည် တစ်စုံတစ်ရာကို တစ်ဦး တစ်ယောက် ထံသို့ ရောက်ရှိအောင် အပ်နှင်းလိုက်သည် ဟူသည့် အနက်တူသော်လည်း ပေးကမ်း ဟု သုံးနှုန်းပါက ပေး ကြိယာကိုသာ ဦးဆောင်ကြိယာအဖြစ် တွေးမိကြသည်။ ကမ်း ကြိယာ၏ အနက်မှာ အနည်းငယ် မြုပ်နေသည်ဟု ယူနိုင်သည်။

ကမ်းပေး ဟူသည့် ကြိယာပေါင်းသည်လည်း ‘တစ်စုံတစ်ရာကို တစ်ဦးတစ်ယောက်ထံသို့ လှမ်းပေးသည်၊ ဝေငှသည်’ ဟူသည့် အနက်ရှိသည်။ ကမ်းပေး တွင်လည်း ကမ်း မှာ ဦးဆောင်ကြိယာ ဖြစ်သည်။ ကမ်းပေး ဟု သုံးနှုန်းပါက တစ်ဦးတစ်ယောက်ထံသို့ လက်ဖြင့် ပေးလိုက်သည်ဟု မြင်ယောင်မိသည်။ ပေး နှင့် ကမ်း တို့သည် တစ်စုံတစ်ရာကို တစ်ဦးတစ်ယောက်ထံသို့ ရောက်ရှိအောင် အပ်နှင်းလိုက်သည် ဟူသည့် အနက်တူ သော်လည်း ကမ်းပေး ဟု သုံးနှုန်းပါက ကမ်း ကြိယာ ကိုသာ ဦးဆောင်ကြိယာအဖြစ် တွေးမိကြသည်။ ကမ်းပေး ဟု သုံးနှုန်းပါက အပြုအမူကို ပထမ မြင်ယောင်မိ သောကြောင့် ကမ်း ကို ဦးဆောင်ကြိယာဟု ဆိုခြင်းဖြစ်သည်။

ဖော်ပြပါ ပေး နှင့် ကမ်း စကားလုံးနှစ်လုံးတို့သည် ဦးဆောင်ကြိယာများဖြစ်ပြီး အနက်မှာ တူကြသော်လည်း ထိုကြိယာတို့ကို ရှေ့နောက်ပြောင်းပါက ဦးဆောင်ကြိယာပြောင်းပြီး အနက်လျော့ သွားကြောင်း တွေ့ရပါသည်။

၂။ ၄။ စာပေတွင်အသုံးများသောကြိယာပေါင်းများ

စာပေတွင်သုံးသော ကြိယာများဆိုသည်မှာ စကားပြေ၊ ကဗျာစသည့် မြန်မာစာပေ ရေးဖွဲ့ရာတွင် အသုံးများသော ကြိယာများကို ဆိုလိုခြင်းဖြစ်သည်။ ကျူးရင့်-ရင့်ကျူး၊ ကျူးလွန်-လွန်ကျူး၊ ကျန်လပ်-လပ်ကျန်၊ ကျိန်းစက်-စက်ကျိန်း၊ ကြေကွဲ-ကွဲကြေ၊ ကွန်မြူး-မြူးကွန်၊ ကြွချီ-ချီကြွ၊ ကြွမ်း-မြန်းကြွ၊ ကြွေးရင့်-ရင့်ကြွေး၊ ကြဲဖြန့်-ဖြန့်ကြဲ၊ ကျွေးမွေး-မွေးကျွေး စသည့်ဖြင့် လုံးချင်းကြိယာတို့ကို ရှေ့နောက် လှယ်၍ ကြိယာပေါင်းဖွဲ့ပါက စာပေရေးသားရာတွင် အသုံးများသော ကြိယာများ ဖြစ်ကြောင်း တွေ့ရသည်။^၀

မြဲငုံသုံးသပ်ချက်

မြန်မာလူမျိုးတို့ နေ့စဉ် ပြောဆို သုံးနှုန်း ရေးသားနေသော မြန်မာကြိယာပေါင်းများ၏ အနက်အဓိပ္ပာယ်ကို လေ့လာဆန်းစစ်ထားပါသည်။ ကြိယာပေါင်းတို့တွင်ပါဝင်သည့် လုံးချင်းကြိယာ များ၏ ဖွဲ့စည်းပုံပြောင်းလဲသောအခါ ဖြစ်ပေါ်လာသည့် အနက်သက်ရောက်မှုကို လေ့လာထားသည့် စာတမ်းဖြစ်ပါသည်။

မြန်မာဘာသာစကားသည် ဧကဝဏ္ဏဘာသာစကား ဖြစ်သောကြောင့် စကားလုံးတိုင်းတွင် အနက်ရှိပါသည်။ လုံးချင်းကြိယာတိုင်းတွင်လည်း အနက်ရှိပြီး ထိုလုံးချင်းကြိယာတို့ကို ပေါင်းစပ်ထားသော ကြိယာပေါင်းတို့တွင်လည်း အနက်များ ရှိပါသည်။ ထူးခြားသည်မှာ လုံးချင်းကြိယာ နှစ်လုံးပေါင်းစပ်ရာတွင် အနက်အဓိပ္ပာယ်အရကြည့်ပါက ကြိယာတို့သည် အပြိုင်ပေါင်းခြင်း ရှိသကဲ့သို့ ကြိယာတစ်လုံးထဲက ဦးဆောင်နေသော ပေါင်းစပ်ခြင်းများ၊ ကြိယာမှ အဆင့်လျော့သွားသော ကြိယာပေါင်းများ စသည်ဖြင့် အမျိုးမျိုး တွေ့ရပါသည်။ အနက်အားဖြင့် မူလလုံးချင်း ကြိယာတို့တွင်ရှိသော အနက်နှင့် တူသည်လည်းရှိပြီး အနက်ပြောင်းခြင်း၊အနက်လျော့သွားခြင်း တို့ကိုလည်း တွေ့ရပါသည်။

နိဂုံး

မြန်မာဘာသာစကား၏ အပြောဘာသာစကား၊ အရေးဘာသာ စကား နှစ်ခုစလုံးတွင် သုံးနှုန်းနေသော မြန်မာကြိယာ တို့ကို ဘာသာဗေဒရှုထောင့် လေ့လာထားပါသည်။ ကြိယာတို့၏ ဖွဲ့စည်းပုံကို အခြေခံပြီး ကြိယာတို့၏ အနက်ကို ဆန်းစစ် လေ့လာထားခြင်း ဖြစ်သည်။ ဆက်လက်၍လည်း ဆန်းစစ် လေ့လာစရာ ကြိယာများစွာ ကျန်ရှိပါသေးသည်။ မြန်မာလူမျိုးတို့၏ စာပေ၊ ယဉ်ကျေးမှု အတွေးအခေါ်များ ထင်ဟပ် နေသည့် အနက်ဆန်းစစ်လေ့လာမှုဖြစ်ပြီး၊ မြန်မာဘာသာစကားကို စိတ်ပါဝင်စားသူများအတွက် အကျိုးရှိမည်ဟု ယူဆမိ ပါသည်။

ကျမ်းကိုးစာရင်း

မြန်မာဘာသာ

ခင်ခင်အေး၊ဒေါ် ။ (၁၉၆၆)။ *ဘာသာဗေဒအခြေခံ*။ တက္ကသိုလ်ပညာပဒေသာစာစောင် (အတွဲ-၁၊ အပိုင်း-၄၂)

ထွန်းမြင့်ဦး ။ (၂၀၀၇)။ *ဘာသာဗေဒ*၊ (တ-ကြိမ်)။ ရန်ကုန်၊ ရာပြည့်စာအုပ်တိုက်။

မြန်မာသဒ္ဒါ ။ (၂၀၀၅)။ ရန်ကုန်၊ မြန်မာစာအဖွဲ့ဦးစီးဌာန။

မြန်မာအဘိဓာန် ။ (၂၀၀၆)။ ရန်ကုန်၊ မြန်မာစာအဖွဲ့ဦးစီးဌာန။

အင်္ဂလိပ်ဘာသာ

Crystal, David. (2003). *A Dictionary of Linguistics & Phonetics* (fifth edition). UK; Black Well.

မြန်မာနိုင်ငံတွင် ခေါင်းလောင်းများစတင်သွန်းလုပ်လာခြင်းနှင့် ခေါင်းလောင်းစာ များစတင်ရေးထိုးလာခြင်း

နီနီအောင်*

စာတမ်းအကျဉ်း

ဤစာတမ်းသည် မြန်မာနိုင်ငံ၌ ခေါင်းလောင်းများစတင်သွန်းလုပ်လာပုံနှင့် ကမ္ဘာ့စာများ စတင်ရေးထိုးလာပုံတို့ကို သုတေသနပြုထားသော စာတမ်းတစ်စောင်ဖြစ်သည်။ သုတေသန ပြုရာတွင် မြန်မာနိုင်ငံအတွင်း တွေ့ရှိခဲ့ရသော ခေါင်းလောင်းများနှင့် ပတ်သက်သော မှတ်တမ်း များနှင့် ခေါင်းလောင်းများကို အလေ့လာခံ အဖြစ်အသုံးပြုခဲ့ပါသည်။ သုတေသန ပြုရာတွင် ပညာရပ်ဆိုင်ရာ နည်းနာအဖြစ် ကမ္ဘာ့စာလေ့လာနည်း (Epigraphy) ကို အသုံးပြု ထားသည်။ သုတေသန နည်းနာအဖြစ်ရှိပြီး အချက်အလက်များ အပေါ်အခြေခံလေ့လာခြင်း (Use of Available Data)ကို အသုံးပြုပြီး ခေါင်းလောင်းများစတင်သွန်းလုပ်လာခြင်းနှင့် ကမ္ဘာ့စာ များ စတင်ရေးထိုးလာခြင်းတို့ကို သုတေသနပြုတင်ပြထားပါသည်။ဤစာတမ်းကို ပြုစုရခြင်း ရည်ရွယ်ချက်မှာ-မြန်မာ့ယဉ်ကျေးမှု အနုပညာ ပန်းတဦးအတတ်နှင့် ရှေးဟောင်းစာပေတို့ကို ဖော်ထုတ်ရန် ဖြစ်ပါသည်။

သော့ချက်ပေါ်ဟာရ- ခေါင်းလောင်းအဓိပ္ပာယ်၊ ခေါင်းလောင်းစာအဓိပ္ပာယ်၊ ခေါင်းလောင်းများစတင် အသုံးပြုလာခြင်း၊ ကမ္ဘာ့စာမှတ်တမ်းစာများစတင်ရေးထိုးလာခြင်း

နိဒါန်း

ခေါင်းလောင်းစာများသည် ကျောက်စာ၊ မင်စာ၊ ပေစာ၊ ပုရပိုက်စာ၊ အုတ်ခွက်စာ၊ သင်္ချိုင်းစာများကဲ့သို့ စာပေအထောက်အထားများ၊ သမိုင်းအထောက်အထားများကို ဖော်ပြပေး သော ကမ္ဘာ့စာမှတ်တမ်း စာများဖြစ်သည်။ အဆိုပါ မှတ်တမ်းစာများပါသော ခေါင်းလောင်း များသည် သဘာဝဘေး အန္တရာယ် ကြောင့်ဆုံးရှုံးခဲ့ရသည်လည်းရှိသည်။ သဒ္ဒါတရားလွန်ကဲသော အလှူရှင်တို့၏ ရွှေချလှူဒါန်းမှု ကြောင့် လည်းကောင်း၊ ခေါင်းလောင်းများပေါ်တွင် soft pern (ဆော့ပန်)များ correction pern (မင်ဖျက်ဘောပင်) များဖြင့် စာများ ရေးသားမှုကြောင့် လည်းကောင်း အလှူမှတ်တမ်းစာများ ပျက်စီး ပျောက်ကွယ် ခဲ့ရသည်လည်းရှိသည်။ ထို့ကြောင့် မြန်မာ့ရိုးရာ ပန်းတဦးလက်ရာ ခေါင်းလောင်းများနှင့် အလှူကမ္ဘာ့စာများကို ထိန်းသိမ်း ဖော်ထုတ်လိုသဖြင့် ဤစာတမ်းကို ပြုစုခဲ့ရခြင်းဖြစ်ပါသည်။

ဤစာတမ်းတွင် မြန်မာနိုင်ငံ၌ တွေ့ရှိခဲ့ရသော ခေါင်းလောင်းများကို အလေ့လာခံ အဖြစ်သတ်မှတ်ပြီး သုတေသနပြု ထားပါသည်။ ခေါင်းလောင်းစာနှင့် ပတ်သက်၍ ရှေးဟောင်း သုတေသန ဌာနမှ ပညာရှင်အသီးသီးတို့၏ သုံးသပ်ချက်များ၊ မှတ်တမ်းဓါတ်ပုံများ၊ ခေါင်းလောင်း စာမူရင်းများ၊ ကိုယ်တိုင်ကွင်းဆင်း လေ့လာတွေ့ရှိချက်များ၊ မှတ်တမ်းများဖြင့် စိစစ်ဖော်ထုတ်ပြီး လေ့လာ တင်ပြထားပါသည်။

* ဒေါက်တာ၊ တွဲဖက်ပါမောက္ခ၊ မြန်မာစာဌာန၊ ရန်ကုန်အရှေ့ပိုင်းတက္ကသိုလ်

ဤစာတမ်းတွင် ခေါင်းလောင်းများ စတင်အသုံးပြုလာခြင်းနှင့် အလှူမှတ်တမ်း ကမ္မည်းစာများစတင် ရေးထိုးလာခြင်း တို့ကို တင်ပြထားသဖြင့် ဘာသာစကားလေ့လာလိုသူများအတွက် အကျိုးဖြစ်စေပါသည်။

ခေါင်းလောင်းအဓိပ္ပာယ်

ခေါင်းလောင်းဟုဆိုရာတွင် ရွှေ၊ ငွေ၊ ကြေး၊ သံ၊ ခဲတို့ဖြင့် ပြုလုပ်ထားသော ဆည်းလည်းများ၊ ခေါင်းလောင်းငယ်လေး များမှသည် မြန်မာနိုင်ငံတွင်အကြီးဆုံး မင်းကွန်းခေါင်းလောင်းကြီးအထိ ပုံစံအမျိုးမျိုး အရွယ်အစုံစုံ သွန်းလုပ်ထားသော ခေါင်းလောင်းမျိုးကို ဆိုလိုပါသည်။

ခေါင်းလောင်းကို မြန်မာအဘိဓာန်တွင် -

ခေါင်းလောင်း၊ န-၁၊ ကြေးငွေစသည်ဖြင့် သွန်းလုပ်ထားသည့်

လုံးပတ်ဝန်း၍ အဝကားသော တီးခတ်ရာပစ္စည်း။

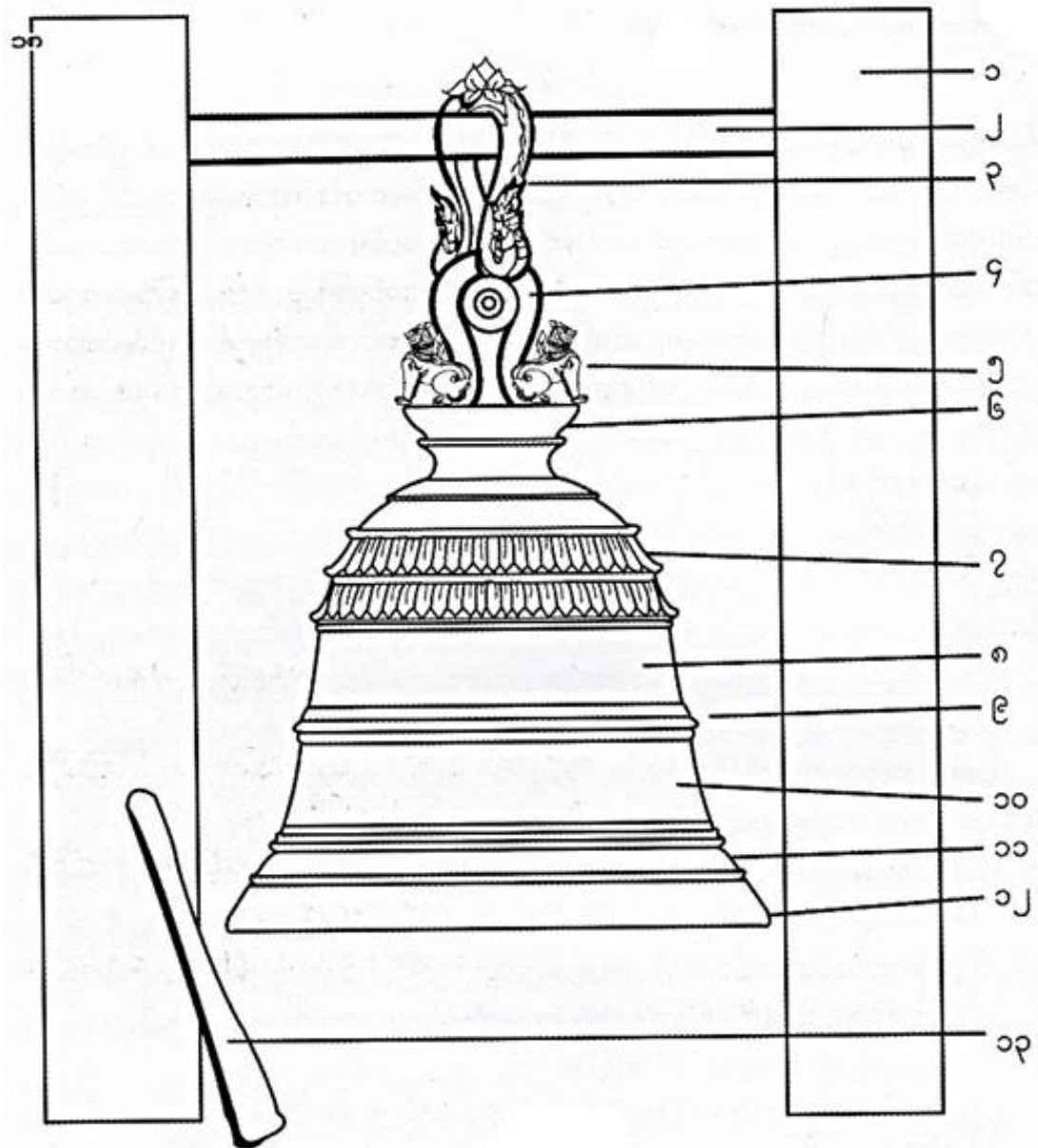
၂၊ အခေါင်းတွင်းရှိအဆန်ကို လှုပ်ခတ်၍ အသံမြည်စေသော

ခွက်ပုံသတ္တုကိရိယာ။ (မြန်မာအဘိဓာန်၊ ၂၀၀၈၊ ၅၆။)

ဟု ဖွင့်ဆိုထားပါသည်။

ထို့ကြောင့် ခေါင်းလောင်းဆိုသည်မှာ အခေါင်းပေါက်ပါသော ရွှေ၊ ငွေ၊ ကြေး၊ သံ၊ ခဲ စသည့်သတ္တု ပစ္စည်းတစ်မျိုးနှင့်ဖြစ်စေ၊ သတ္တုပစ္စည်း နှစ်မျိုး၊ သုံးမျိုး စသည်ဖြင့်ရောနှော၍ ဖြစ်စေ လိုရာပုံဖော် သွန်းလုပ်ထားသော အနုပညာလက်ရာ ပစ္စည်းတစ်မျိုး ဖြစ်သည်။ ပုံဖော် သွန်းလုပ်ရာတွင် ကိုင်လှုပ်စရာ လက်ကိုင်ပါသော ခေါင်းလောင်းနှင့် ချိတ်ဆွဲနိုင်သောခေါင်းလောင်းတို့ကို သွန်းလုပ်လေ့ရှိသည်။ အချို့ခေါင်းလောင်းများတွင် အဆန်ပါပြီး အချို့တွင် အဆန်မပါရှိပေ။ ယင်တို့တုတ်တံဖြင့် ထိုးခတ်၍ဖြစ်စေ၊ လှုပ်ခတ်၍ဖြစ်စေ အသံမြည်အောင် တီးခတ်ရပါသည်။

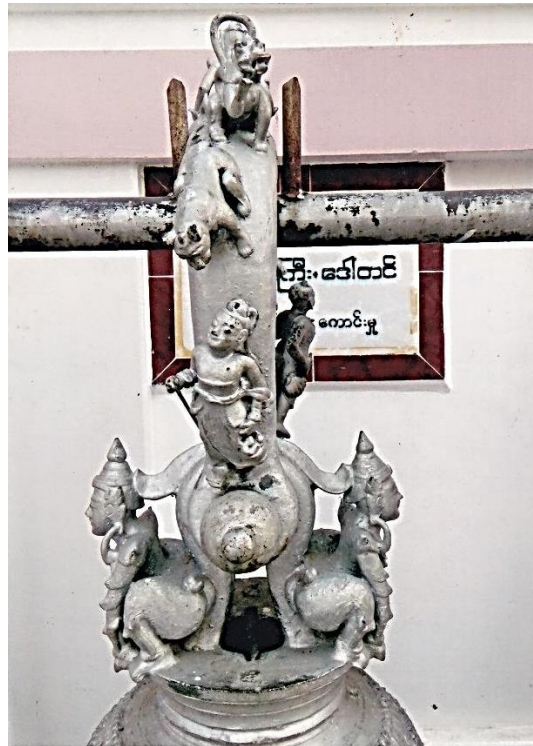
အချို့သောမြန်မာခေါင်းလောင်းများတွင် အရုပ်ခံပလ္လင်နှင့် ခေါင်းလောင်းထမ်းတန်းကြား ပုစွန်တုပ်ကွေးခေါ်ခေါင်းလောင်းကိုင်း၏ ဘယ်ညာနှစ်ဘက်တွင် သိဒ္ဓတ္ထမင်းသားတော ထွက်ခန်း၊ သိဒ္ဓတ္ထမင်းသား ဆံတော်ပယ်ခန်း၊ ဝေဿန္တဇာတ်တော်၊ ဝိဇ္ဇာဇာတ်တော်၊ သုဝဏ္ဏ သာမဇာတ်တော်၊ ဘူရိဒတ်ဇာတ်တော်စသည့် ငါးရဲ့ငါးဆယ် ဇာတ်တော်များကို သရုပ်ဖော်၍ မြန်မာ့ အနုပညာပန်းတဦး လက်ရာများကို ပုံဖော်သွန်း လုပ်ထားတတ်ကြသည်။ အရုပ်ခံပလ္လင် တွင် ခြင်္သေ့ရုပ်၊ မနုဿီဟရုပ်၊ နဂါးရုပ်၊ ပဉ္စရူပရုပ်၊ သိကြားမင်းရုပ်၊ ဇော်ဂျီရုပ်၊ ကိန္နရီ၊ ကိန္နရာရုပ်၊ နယားရုပ်စသည့် အရုပ်တစ်မျိုးမျိုးဖြင့် ပုံဖော်ပြီး အရုပ်ခံပလ္လင် အောက်တွင် ကြာထပ်၊ ကြာမှောက်၊ ကြာကလပ် ရှိသည်။ ကြာမှောက်ကြာကလပ်နှင့် ပထမဖောင်းရစ် ကြားကွက်လပ် ဒုတိယ ဖောင်းရစ်ကြား ကွက်လပ်တို့တွင် ကမ္မည်းစာများရေးထိုး မှတ်တမ်းတင် တတ်ကြပါသည်။ ထိုကမ္မည်းစာများ ဘေးတွင်လည်း ကနုတ်ပန်းအလှအပများ၊ အစက်အပြောက် များ၊ အကွက်များ၊ ညောင်ရွက်ပုံများ စသည်တို့ဖြင့် တန်ဆာဆင်ကာ မြန်မာ့အနုပညာ လက်ရာများကို ပုံဖော် ထားတတ်ကြပါသည်။ (ပုံ-၁၊ ၂၊ ၃၊ ၄၊ ၅)



ပုံ(၁)

ခေါင်းလောင်းချိတ်ဆွဲထားပုံနှင့် အစိတ်အပိုင်း အခေါ်အဝေါ်များ

- | | |
|---------------------------------------|---|
| ၁။ ခေါင်းလောင်းတိုင် | ၈။ ပထမဖောင်းရစ်ခေါင်းလောင်းစားများ |
| ၂။ ခေါင်းလောင်းထမ်းပိုးတန်း | ရေထိုးသည့်နေရာ |
| ၃။ ခေါင်းလောင်းချိတ် (သို့)ကိုင်း | ၉။ ခါးလယ်ဖောင်းရစ် |
| ၄။ ပုဇွန်တုတ်ကွေး | ၁၀။ ဒုတိယဖောင်းရစ်ခေါင်းလောင်းစားများ |
| ၅။ ခြင်္သေ့ (သို့မဟုတ်) မနုဿီဟရုပ် | ရေထိုးသည့်နေရာ |
| ၆။ ခြင်္သေ့ (သို့မဟုတ်) အရုပ်ခံပလ္လင် | ၁၁။ အိုးစည်နား (သို့မဟုတ်) နှစ်လေးပေါက် |
| ၇။ ကြာထပ် | ၁၂။ ခေါင်းလောင်းနှုတ်ခမ်း |
| | ၁၃။ ခေါင်းလောင်းထိုးတံ |



ပုံ (၂) မနုဿီဟရုပ်ခံပလ္လင်ပေါ်ရှိ ဝေဿန္တရာဇာတ်တော်ကို ပုံဖော်ထားသောခေါင်းလောင်း



ပုံ(၃) ခြင်္သေ့ရုပ်ခံပလ္လင်ပေါ်ရှိဝသုဇ္ဈန္ဒနတ်သားဆံတော်မှ ရေချဟန်ပါသောခေါင်းလောင်း



ပုံ(၄) ခြင်္သေ့ခေါင်း၊ဂဠုန်လက်သည်း၊ငါးကြေးခွံနှင့်
အမြီးပါသောမကန်းခြောက်ကောင်ပုံဖော်ထားသောခေါင်းလောင်း



ပုံ(၅) စဉ့်ကူးမင်း ခေါင်းလောင်း၏ ပုဇွန်ထုပ်ကွေးတွင် ခေါင်းလောင်း(မဟာဃဏ္ဍ) နဂါးရုပ် ထုထားသည်။
ပေါင်းကိုင်းအလယ်တွင် နတ်သားရုပ်ပါရှိသည်။ နတ်သားရုပ် အောက်တွင် ခြင်္သေ့ရုပ်များကို
တစ်ဖက်တစ်ကောင်စီရှိထားသည်။ ၎င်း၏ဘေးတစ် ဖက်တွင် နတ်သားရုပ်နှင့် အခြားတစ်ဖက်တွင်
နတ်သမီးရုပ်ရှိရှိထားသည်။

ခေါင်းလောင်းစာအဓိပ္ပာယ်

ခေါင်းလောင်းစာ ဟူသည် ခေါင်းလောင်း၏ကိုယ်ထည်၊ များသောအားဖြင့် ခေါင်းလောင်းကိုယ်ထည်၏ ပထမဖောင်းရစ်နှင့် ဒုတိယဖောင်းရစ် တို့အကြားတွင် မှတ်တမ်းတင်ရေးထိုးထားသော ကမ္ဗည်း အက္ခရာများပင် ဖြစ်သည်။ မိမိတို့၏ ဒါနအစုစုတို့ကို နှောင်းလူတို့ သာဓု အနုမောဒနာ ခေါ်ဆိုနိုင်ရန် အတွက် လည်းကောင်း၊ ဗုဒ္ဓသာသနာ ငါးထောင် တည်တံ့စေရန် အတွက်လည်းကောင်း ရည်ရွယ်၍ မှတ်တမ်းတင် ရေးထိုးထားခြင်းဖြစ်သည်။

ကမ္ဗည်း မှတ်တမ်းများတွင်လည်း အမျိုးအစားနှစ်မျိုး တွေ့ရသည်။ ယင်းတို့မှာ မူလထိုး ခေါင်းလောင်းစာနှင့် ဆင့်ထိုး ခေါင်းလောင်းစာတို့ ဖြစ်သည်။ မူလထိုး ခေါင်းလောင်းစာမှာ မူလအလှူရှင် တို့က ခေါင်းလောင်းသွန်းလုပ်ပြီး အလှူမှတ်တမ်းတင်ထားသော ခေါင်းလောင်းစာများ ဖြစ်သည်။

- ရန်ကုန်မြို့၊ ရွှေတိဂုံစေတီတော်ရင်ပြင် ရာဟုထောင့်ရှိ စဉ့်ကူးမင်း၏ ကောင်းမှုတော် မဟာဗန္ဓုခေါင်းလောင်းစာ၊
- ရန်ကုန်မြို့၊ ရွှေတိဂုံစေတီတော်ရင်ပြင် တနင်္ဂနွေထောင့်ရှိ သာယာဝတီမင်း၏ ကောင်းမှုတော် မဟာတိသဒ္ဓဗန္ဓုရာဇာ ခေါင်းလောင်းစာ၊
- ပြည်မြို့၊ ရွှေဆံတော်ဘုရားရင်ပြင် ရာဟုထောင့်ရှိ ရတနာပူရ ရွှေမြို့တော်နေ မင်းရာဇာကျော်ထင်ဘွဲ့ရ မောင်အောင်သူနှင့်ဇနီး ရှင်မင်ရောက်မိသားစု၏ ကောင်းမှုတော် ဘိလပ်ပြန်ခေါင်းလောင်းစာ၊
- ပြည်မြို့၊ ရွှေဆံတော်ဘုရားရင်ပြင်တော် တောင်ပိုင်ဘိုးဘိုးကြီး နန်းဆောင်ရှေ့ရှိ သရေခေတ္တရာ မြို့အုပ် မောင်မြတ်ကြီးဇနီးမောင်နှံ၏ ကောင်းမှုတော်ခေါင်းလောင်းစာ စသည်တို့သည် မူလထိုး ခေါင်းလောင်းစာများဖြစ်ပါသည်။

ဆင့်ထိုးခေါင်းလောင်းစာဟူသည် မူလအလှူရှင်တို့ မှတ်တမ်းတင် ရေးထိုးထားသော ခေါင်းလောင်း မှာ အချိန်ကြာမြင့်၍ ပျက်စီးယိုယွင်းနေသော ခေါင်းလောင်းကို ထပ်မံပြုပြင်မွမ်းမံ ခဲ့သူတို့က ဖြည့်စွက် ရေးထိုးထားသော မှတ်တမ်းစာဖြစ်သည်။ ထိုစာများကို ဆင့်ထိုး ခေါင်းလောင်းစာ သို့မဟုတ် နောက်ထိုး ခေါင်းလောင်းစာ ဟုခေါ်သည်။

ပြည်မြို့၊ ရွှေဆံတော် စေတီရင်ပြင် အင်္ဂါထောင့်ရှိ ဝန်ထောက်မင်း ဦးစောနန်းနှင့် ဝန်ထောက်ကတော် မယ်သင် ဇနီးမောင်နှံကောင်းမှု ခေါင်းလောင်းစာသည် ဆင့်ထိုးခေါင်း လောင်းစာ ဖြစ်သည်။ ဝန်ထောက်မင်း ဦးစောနန်းနှင့် ဇနီးမယ်သင်တို့၏ အလှူခေါင်းလောင်း ကမ္ဗည်းစာတွင် မြန်မာသက္ကရာဇ် ၁၂၄၃-ခုနှစ်၊ နှောင်းတန်ခူးလပြည့်ကျော် ၁ရက်နေ့တွင် မဟာသမန်းမြို့ ဝန်ထောက်တော်မင်း ဦးစောနန်း၊ ဝန်ထောက်ကတော် မယ်သင် ဇနီးမောင်နှံကောင်းမှု၊ နတ်လူ သာဓုခေါ်စေသော်ဟု ဒုတိယ ဖောင်းရစ်တွင် ရေးထိုးထားသည်။ ပထမဖောင်း ရစ်တွင် မြန်မာသက္ကရာဇ် ၁၃၀၃-ခုနှစ် တန်ဆောင်မုန်းလဆုတ် ၁၂-ရက်နေ့တွင် ဒါလဟိုဇီ ဝန်ထောက်ကြီး ဦးဘအုန်း၊ ဝန်ထောက်ကတော် ဒေါ်အေးကြည် (မဟာသမန်းမြို့ ဝန်ထောက်မင်း ဦးစောနန်း၊

ဒေါ်သင်မြေးများ)တို့က ထပ်မံပြုပြင် လှူဒါန်းပါသည်ဟု ရေးထိုးထားသဖြင့် အဆိုပါ ခေါင်းလောင်း သည်လည်း ဆင့်ထိုး ခေါင်းလောင်းစာဖြစ်သည်။

ထို့ပြင် ပြည်မြို့ ရွှေဆံတော်စေတီရင်ပြင် အရှေ့ဘက်စောင်းတန်းရှိ ခြေရာတစ်ထောင် မောင်မခေါင် ဂူ၏ နောက်ကျောဘက်တွင် ရှိသော ခေါင်းလောင်းစာ (မ.၁၂၄၈) သည်လည်း ဆင့်ထိုး ခေါင်းလောင်းစာ ပင်ဖြစ်သည်။ အဆိုပါခေါင်းလောင်းတွင် အကိုဖြစ်သူ ဦးနု၊ ဒေါ်သာဖြူ မိသားစုမှ သွန်းလုပ်လှူဒါန်းခဲ့သော ခေါင်းလောင်းကွဲ ပျက်နေပါသဖြင့် သားထွေးဖြစ်သော ဦးရွှေမိုး မိသားစုတို့က ထပ်မံသွန်းလုပ် လှူဒါန်းထားသည့် အကြောင်း ရေးထိုးထားသည်။

ရေစကြိုမြို့၊ ပခန်းကြီးစည်သူရှင် ဘုရားရှိ ရှင်ပညာဂမ္ဘိခေါင်းလောင်းစာသည်လည်း ဆင့်ထိုး ခေါင်းလောင်းစာ ပင်ဖြစ်သည်။ ရေစကြိုမြို့နယ်၊ ပခန်းကြီးစည်သူရှင်ဘုရားရှိ ရှင်ပညာ ဂမ္ဘိခေါင်းလောင်းမှာ မြန်မာသက္ကရာဇ် ၁၀၇၀ ပြည့် တပို့တွဲလဆန်း ၁၀ ရက် စနေနေ့တွင် သွန်းလုပ် လှူဒါန်းခဲ့သော ညောင်ရမ်းခေတ် စနေမင်းလက်ထက် ခေါင်းလောင်း တစ်လုံးဖြစ်သည်။ ခေါင်းလောင်း၏ ကိုယ်ထည် အောက်ပိုင်းတွင် “မင်ခင်ဘုံတော်ကြီ ရှင်သာရဓမ္မ၊ သဗ္ဗံရှင်ပညာ ဃမ္ဘိ နှိပ် ဆော်ဝံ ဤခေါင်လောင်ကြီ ကြေ ၃၀၀ကြော်မျိုဝံ ရှေ့မင်ခင်ကျောင် ၃ သွန်လုပ်၍ လူသည်” ဟု မှတ်တမ်းတင်ထားသည်။ ခေါင်းလောင်းကိုယ်ထည် အထက်ပိုင်းတွင် မင်းကင်းကျောင်းတိုက် ဆရာတော်ရှင်သာရဓမ္မ နောက်ဆက်ခံသော ရှင်ပညာဂမ္ဘိသည် ကူးခန်းရွာမှ သီလရှင် ငါးပါးနှင့် ဒါယကာ၊ ဒါယိကာမတို့ထံအလှူခံ၍ ခေါင်းလောင်းကို ပြုပြင်မွမ်းမံခဲ့ကြောင်း ရေးထိုးထားသည်။ ထို့ကြောင့် အဆိုပါခေါင်းလောင်းကိုလည်း ဆင့်ထိုး ခေါင်းလောင်းစာ ပါသော ခေါင်းလောင်းအဖြစ် လေ့လာသိရှိခဲ့ရပါသည်။

ခေါင်းလောင်းစာတွင် ပထမအလှူရှင်မှာ “ခေါင်လောင်ကြီ ကြေ ၃၀၀ ကြော်မျို ရှေ့မင်ခင်ကျောင် ၃ သွန်လုပ်၍လှူသည်” ဟု မှတ်တမ်းတင်ထားသည်။ ဒုတိယအလှူရှင်မှာ “ဘရဆုကိုအလိုရှိ၍ သာတပွ တကာညီညွတ်၍ ခေါင်လောင်းကြီးကို စည်သူရှင်မွေတော်ပြင်၌ လှူသှ် ကောင်မှုကိုနှိပ်ဆော်ပေသသှ်” ဟုပါရှိရာ ဤခေါင်းလောင်းကို ပထမမင်းကင်းကျောင်း ၌ထားရှိရာမှ ပခန်းစည်သူရှင်ဘုရား ရင်ပြင်တော်သို့ ပြောင်းရွှေ့လှူဒါန်းခဲ့ပုံ ရပါသည်။

မြန်မာနိုင်ငံတွင် ခေါင်းလောင်းများ စတင်သွန်းလုပ်လာခြင်းနှင့် ခေါင်းလောင်းစာ များစတင် ရေးထိုးလာခြင်း

နိုင်ငံအချင်းချင်း ကုန်ကူးသန်းရောင်းဝယ်ရာမှ ဘာသာရေး၊ လူမှုရေး၊ ယဉ်ကျေးမှု အနုပညာရပ် များ ပေါင်းကူး ဆက်နွှယ် ခဲ့ကြသည်။ မင်းဧကရာဇ် အချင်းချင်း လက်ဆောင်ပဏ္ဏာများ အပြန်အလှန် ဆက်သရာတွင်လည်း သာသနိကပစ္စည်းများ ပါဝင်လာခြင်း၊ ဗုဒ္ဓသာသနာ ပြန့်ပွားစေရန် သာသနာပြု ပုဂ္ဂိုလ်များ စေလွှတ်ခဲ့ခြင်းတို့ကြောင့် ဗုဒ္ဓသာသနာ တော်သည် တဖြည်းဖြည်း ပျံ့နှံ့လာခဲ့ရသည်။ ဤသို့ဖြင့် ဗုဒ္ဓသာသနာတော် သည်လည်း သီဟိုဠ်မှတစ်ဆင့် သထုံ သရေခေတ္တရာ၊ ပုဂံ စသော နယ်တဝိုက်သို့ ပျံ့နှံ့ခဲ့ပေသည်။ မင်းနှင့်ပြည်သူ စိတ်ညီတူကာ သာသနာကို အကြောင်းပြု၍ ဗုဒ္ဓစာပေ၊ ယဉ်ကျေးမှုအနုပညာ၊ ဓလေ့ထုံးစံ စသည်တို့ ပျံ့ပွားလာအောင် စွမ်းဆောင် ခဲ့ကြသည်။

ဗုဒ္ဓဘာသာဝင်တို့၏ ယုံကြည်ချက်အရ ရှင်တော်ကိုယ်စား ဘုရားဆင်းတုတော်များ သွန်းလုပ် ပူဇော်ခဲ့ကြသည်။ ထိုမှတစ်ဆင့် ဘုရားစေတီ ဂူကျောင်းဧရိယာ စသော သာသနိက အဆောက် အအုံများ ဆောက်လုပ်လှူဒါန်းလာခဲ့ကြသည်။ တန်ဆောင်း၊ ပြာသာဒ် စသည်တို့ကို အတင့် အတယ်ဖြစ်အောင် လှပဆန်းကြယ်လာအောင် မြန်မာ့အနုပညာလက်ရာများဖြင့် အနုစိတ် မွမ်းမံခြယ်သခဲ့ကြသည်။ သဒ္ဓါတရား ထက်သန်လှသော ဗုဒ္ဓဘာသာဝင်တို့သည် မိမိတို့၏ အလှူဒါနအစုစုတို့ကို အများသူငါ သာဓုခေါ်ဆိုနိုင်ရန် အလှူမှတ်တမ်းတင် ကမ္မည်းရေးထိုးခဲ့ကြ သည်။ ကမ္မည်းရေးထိုးရာတွင် တချို့က ကျောက်ချပ်များပေါ်တွင် မှတ်တမ်းတင်သကဲ့သို့ တချို့ကလည်း သဒ္ဓါဒါန(အသံအလှူ)အဖြစ် လှူဒါန်း ထားသော ခေါင်းလောင်း ကိုယ်ထည်တွင် မှတ်တမ်းတင်ခဲ့ကြသည်။

မိမိတို့၏ မွန်မြတ်သန့်စင်သော အလှူဒါနကို ရေစက်သွန်းချ အမျှပေးဝေသကဲ့သို့ သာယာ ချမ်းမြေ့ဖွယ် ခေါင်းလောင်းသံဖြင့်လည်း ကောင်းမှုကို သာဓုအနုမောဒနာ ခေါ်ဆိုစေချင် ခဲ့ကြသည်။ ထို့ကြောင့် ခေါင်းလောင်းထိုး၍ အမျှပေးဝေခြင်းမလေ့သည် ပျံ့နှံ့ခဲ့ပြီး ခေါင်းလောင်း များကိုပါ သာသနိက ပစ္စည်းအဖြစ် ထည့်သွင်းလှူဒါန်းလာခဲ့ကြပါသည်။ ခေါင်းလောင်းကို စေတီတော်၏ ထီးတော်တစ်ဝိုက် ခြံရံချိတ်ဆွဲနိုင်သော ခေါင်းလောင်းငယ် လေးများမှသည် မြန်မာနိုင်ငံတွင် ပထမအကြီးဆုံး မင်းကွန်း ခေါင်းလောင်းကြီးအထိ ပုံစံအမျိုးမျိုး အရွယ်အစုံစုံ သွန်းလုပ် ခဲ့သည်ကို တွေ့ရှိနိုင်ပါသည်။

မြန်မာ့စွယ်စုံကျမ်း အတွဲ(၂)တွင် ခေါင်းလောင်းကို “အေဒီ ၅ ရာစု၊ ၆ ရာစုနှစ် လောက်က အစပြု၍ ခရစ်ယာန် ဘုရားရှိခိုး ကျောင်းများတွင် ခေါင်းလောင်းများ ထားရှိလာ ခဲ့ကြသည်” သာသနာရေး ကိစ္စများသာမက “နန်းတက်ပွဲ၊ လက်ထပ်ပွဲ စသော မင်္ဂလာအခမ်း အနားများ၌လည်း ခေါင်းလောင်းထိုး တတ်ကြသည်။ စစ်ကြီးပြီးဆုံးသည့် အခါ၊ နိုင်ငံလွတ်လပ် သည့်အခါများ ၌လည်း ဝမ်းမြောက်သော အထိမ်းအမှတ်ဖြင့် ခေါင်းလောင်းများကို ထိုးတတ်ကြသည်။ ဘုရင်နတ်ရွာစံသည့် အခါ၌လည်း ဝမ်းနည်းသော အထိမ်းအမှတ်ဖြင့် ခေါင်း လောင်းထိုး တတ်ကြသည်။” (၁၉၉၅၊ စာ-၃၁၇-၃၁၈) မြန်မာ့ရာဇဝင်တွင်လည်း ခေါင်းလောင်းထိုးခြင်းနှင့် ပတ်သက်၍ မှန်နန်း မဟာရာဇဝင် ပထမတွဲတွင်

“ခေါင်းလောင်းကြီး စည်ကြီးတို့ဖြင့် အခွန်ခံသောအခါ တွင်လည်း ဤကဲ့သို့ တစ်ချက် ခတ်တီး သည်ရှိသော် ထိုသို့သော လူမင်း၊ နဂါးမင်းတို့ နားရင်း၌ တီးဘိသကဲ့သို့ ထိုအသံတို့သည် တည်လေ၏။ ထိုအခါ ထိုသို့သော မင်းတို့ သည် ရိုသေခယမ်းသော စကားဖြင့် တောင်းပန်သည်ဖြစ်မှ အသံ စဲသော ဟူ၏”

(၁၉၉၂၊ စာ-၁၇၂)

ဟု ဖော်ပြထားပါသည်။ သရေခေတ္တရာမြို့တည် နန်းတည် ဒွတ္တပေါင်မင်းကြီးသည် ခေါင်းလောင်း ကြီးကို တစ်ချက်တီးခတ်ရုံမျှနှင့် နားမခံနိုင်သဖြင့် လူမင်းနဂါးမင်းတို့ အခွန်ဆက်သရန် ရောက်လာကြ ရသည်ဟု အဆိုရှိသဖြင့် ခေါင်းလောင်းကို သာသနာရေး ကိစ္စများသာမက နိုင်ငံအတွက် အခွန်ကောက်ခံ ရာတွင်လည်း အသုံးပြုမှုရှိကြောင်း တွေ့ရှိရသည်။ ထို့ပြင် ဒေါက်တာ သန်းထွန်း၏ ခေတ်ဟောင်း မြန်မာရာဇဝင်တွင်လည်း ထန်ရာဇဝင် သစ်၌ ပျူတို့ အကြောင်း ဖော်ပြရာတွင်-

“ဘုရင့်နန်းတော်၌ ရွှေခေါင်းလောင်း၊ ငွေခေါင်းလောင်းရှိသည်။ ရန်သူ နီးကပ်လာလျှင် ယင်းခေါင်းလောင်းကို ထိုးခြင်း၊ အမွှေးနံ့သာတို့ကို မီးရှို့ ခြင်းဖြင့် ထိုးသတ်ရမည့်စစ်တွင် အရှုံးအနိုင်ကို ကြိုတင်သိရန် အတိတ် နိမိတ် ယူကြသည်။” (၂၀၀၂၊ စာ-၈၁)

ဟု ဖော်ပြထားပါသည်။ ဦးကုလား၏ မဟာရာဇဝင်တွင်လည်း-

“ထိုမှတစ်ပါး တိုင်းသူပြည်သားများ အတွင်းတွင် တရားစကား အရှက်အတင် ရှိ၍ တရားသူကြီးတို့က ဆုံးဖြတ်ပါသော်လည်း တရားမရ၊ မှန်ကန်ရာသို့ မရောက်သဖြင့် လျှောက်လို သော်လည်း ဆင်းရဲသောကြောင့် မလျှောက် ထား နိုင် သူတို့အတွက် ဒီခေါင်းလောင်းကိုထိုးဟူ၍ တရားခေါင်းလောင်း တရားစည်ကို နန်းတော် ဝင်းတော် ထဲတွင် ဆွဲထားစေခဲ့သည်။” (၁၉၆၀၊ စာ-၂၆၆)

ဟု ဖော်ပြထားရာ ဆင်ဖြူရှင် ဘုရင့်နောင်လက်ထက်တွင် တရားစီရင်ရေး ကိစ္စများကို တရား ခေါင်းလောင်းထိုးကာ စီရင်ဆုံးဖြတ်လေ့ရှိကြောင်း သိရှိရပါသည်။ ထို့ကြောင့် ခေါင်းလောင်းကို ဘာသာရေး ကိစ္စများသာမက နိုင်ငံရေး၊ လူမှုရေး၊ စီးပွားရေးကိစ္စရပ် များတွင်လည်း အသုံးပြု ကြောင်း တွေ့ရသည်။ ထို့ပြင်ကျောင်းတက် ကျောင်းဆင်းချိန် ထိုးသော ခေါင်းလောင်း၊ အိမ်၊ ရုံး၊ ဟော်တယ်စသည်တို့တွင် တပ်ဆင်ထားသော ခေါင်းလောင်းများလည်း ရှိပါသေးသည်။

ခေါင်းလောင်းကို မြန်မာ့နိုင်ငံတွင်သာမက ကမ္ဘာ့နိုင်ငံ အသီးသီးတွင်လည်း သွန်းလုပ်ခဲ့ ကြကြောင်း တွေ့ရသည်။ ကမ္ဘာတွင် ပထမအကြီးဆုံး ခေါင်းလောင်းအဖြစ် ရုရှနိုင်ငံ မော်စကိုမြို့ ရှိ ကရင်မလင် ရင်ပြင်၌ရှိသော ဇာဘုရင်(ဇာကိုလိုကိုး) Tsar kolokol Bell ခေါင်းလောင်း၊ အမေရိကန် ပြည်ထောင်စု ကန်တုကီ Kentucky ပြည်နယ်၊ နယူးပေါ့တ် Newport ထောင်စုနှစ်ပန်းခြံရှိ အမြင့်တွင် ချိတ်ဆွဲထားပြီး လှုပ်ယမ်းထိုး ခတ်နိုင်သော ကမ္ဘာ့ငြိမ်းချမ်းရေး ခေါင်းလောင်း Word Peace Bell ၊ ဆီယွန်ဒက်ဘုရင် (ခရစ်နှစ် ၇၆၅-၇၇၁) အုပ်စိုးစဉ်သွန်း လုပ်ခဲ့သော တောင်ကိုရီးယားနိုင်ငံ၊ ဂျီယွန်ဂျီ Genongji အမျိုးသားပြတိုက်ရှိ ကမ္ဘာတွင် ရှေးအကျဆုံး ခေါင်းလောင်းဖြစ်သည့် ဆီယွန်ဒက် ခေါင်းလောင်း King Seongdeak Bell ၊ ဩစတြီးယားနိုင်ငံ မီယင်နာမြို့ စတီဖင်ဒန် ဘုရားရှိခိုးကျောင်း Setephensdom Cathedral ရှိအမြင့်တွင် ချိတ်ဆွဲထားပြီး လွှဲယမ်းတီးခတ်နိုင်ရန် ကွန်ပျူတာဖြင့် ထိန်းချုပ်ထားသော ပန်မီယင်ခေါင်းလောင်း The Pummerin Bell တို့မှာ ထင်ရှားကျော်စောသော ခေါင်းလောင်းများ ပင်ဖြစ်သည်။(The world largest bells. 2016. wiki)

မြန်မာနိုင်ငံတွင် ခေါင်းလောင်းသွန်းလုပ် လှူဒါန်းခြင်း ဓလေ့သည် ပျူခေတ်မတိုင်မီ ကတည်းက ပေါ်ပေါက်ခဲ့မည်ဟု ခန့်မှန်းရပါသည်။ ပျူခေတ်သို့ ရောက်သောအခါ ခေါင်းလောင်း သွန်းလှူခြင်း အလေ့အထသည် ခိုင်မာနေပြီဖြစ်သည်။ ပြည်မြို့ရှိ သရေခေတ္တရာ မြို့ဟောင်း ရွှေတံခါးအပိုင်း(၃) ဦးမောင်မောင်လွင် ခြံဝင်း(၁၁.၆.၂၀၀၅)၌ တွေ့ရှိသော ဝိဇယ မိုးကြိုးသွား လေးခုနှင့် နတ်မင်း၏ မျက်နှာ ပါရှိသော ကြေးခေါင်းလောင်းသည် ပျူခေတ် လက်ရာ တစ်ခု ဖြစ်သည်။ အဆိုပါ ခေါင်းလောင်းမှာ အမြင့် (၁၅)စင်တီမီတာ၊ ပတ်လည်အနား (၁၅)စင်တီမီတာ၊ အချင်း (၆)စင်တီမီတာရှိပြီး ကြေးညိုနှင့် ပြုလုပ်ထားသော လက်ကိုင်ပါ ခေါင်းလောင်းငယ်

တစ်လုံးဖြစ်သည်။ ခေါင်းလောင်းလက်ကိုင်အရှေ့ဘက်တွင် နတ်တစ်ပိုင်းပုံ မျက်နှာရှိသည်။ ကျောဘက်တွင် ဦးခေါင်းနောက်ပိုင်း ပုံပါရှိသည်။ ထိုနတ်ခေါင်းပိုင်း၏အပေါ် တွင် ဝရဇိန်လက်နက် (မိုးကြိုးသွား)လေးခုဖြင့် တန်ဆာဆင်ပြုလုပ်ထားသည်။ အဆိုပါ ခေါင်းလောင်းကို ပြည်မြို့ရှိ သီရိခေတ္တရာပြတိုက်တွင် ပြသထားပါသည်။

(ပုံ ၆၊ ၇)



ပုံ(၆) ဝရဇိန်လက်နက်(မိုးကြိုးသွား)နှင့်
နတ်တစ်ပိုင်းပုံမျက်နှာရှိသော
ပျူခေတ်လက်ရာ ခေါင်းလောင်းပုံ



ပုံ(၇)နတ်တစ်ပိုင်းပုံမှ ကျောဘက်ခေါင်းပိုင်း၏
အနောက်ခြမ်းပုံ

ခရစ်နှစ် ၁၉၆၇ ခုနှစ်တွင် ပြည်မြို့သရေ ခေတ္တရာမြို့ဟောင်း အရှေ့မြောက်ဘက် မှော်ဇာတွင် ရှိသော ဘုရားမာ (သရမာ) စေတီ ကုန်းအမှတ်(၈)မှ တူးဖော်ရရှိသော ကြေးခေါင်း လောင်းသည် လည်း ပျူခေတ်လက်ရာ တစ်ခုဖြစ်သည်။ အမြင့်(၁၁)လက်မရှိပြီး ခေါင်းလောင်း ကိုယ်ထည်တွင် ပျူခေတ် ဒင်္ဂါးများတွင် ပါလေ့ရှိသော သီရိဝစ္ဆတံဆိပ်ပါ အပြောက်အမွမ်း များခြယ်သထားသည်။ ကမ္ဘည်းစာမှတ်တမ်း ရေးထိုးထားခြင်းကိုမူ မတွေ့ရှိရပေ။ ကိုင်လှုပ် တီးခတ်စရာ လက်ကိုင်မပါဘဲ ချိတ်ဆွဲ တပ်ဆင်နိုင်ရန် ကွင်းပြုလုပ်ထားသဖြင့် ချိတ်ဆွဲ တီးခတ်ရသော ခေါင်းလောင်းငယ် တစ်လုံးပင်ဖြစ်မည်။ ထိုခေါင်းလောင်းကို ရန်ကုန်မြို့ရှိ အမျိုးသားပြတိုက်တွင် ပြသထား ပါသည်။(ပုံ၊ ၈)



(ပုံ)၈ သီရိဝိဇ္ဇာအပြောက်အမွမ်းပါသော ပျူခေတ်လက်ရာကြေးခေါင်းလောင်း

ခရစ်နှစ် ၁၉၉၈-ခုနောက်ပိုင်းတွင် ပြင်သစ်နိုင်ငံ ရှေးဟောင်းသုတေသနပညာရှင်များ နှင့် မြန်မာနိုင်ငံ ရှေးဟောင်း သုတေသန ပညာရှင်များ ပူးပေါင်းလျက် စစ်ကိုင်းတိုင်းဘုတလင် မြို့နယ် ညောင်ကန်နှင့် မုန်ထူးဒေသများ ဌာလည်းကောင်း၊ မန္တလေးတိုင်း၊ မလှိုင်မြို့နယ်၊ မြင်းဦးလှည့်၊ နှောကန် ဒေသများ၌ လည်းကောင်း၊ ဝမ်းတွင်းမြို့နယ် ကုက္ကိုခါးလှ ဒေသ၌လည်း ကောင်း၊ ပျော်ဘွယ်မြို့နယ် ချောင်းမကြီး၊ ဥမင်၊ ထန်းတပင်ရွာထင် ဒေသများ၌လည်းကောင်း၊ တောင်သာ မြို့နယ် အင်းတဲ ဒေသ၌ လည်းကောင်း၊ ရမည်းသင်း မြို့နယ် မြို့လှဒေသ၌လည်း ကောင်း၊ မိတ္ထီလာမြို့နယ် မြောက်လည်၊ ညောင်ကန် ဒေသများ၌ လည်းကောင်း တူးဖော်လေ့ လာမှုများ ပြုလုပ်ခဲ့သည်။ ထို့သို့ တူးဖော်ရာတွင် ကျောက်ချော လက်နက်များနှင့်အတူ ကြေးလက်နက်များကို မြေလွှာတစ်လွှာတည်း၌ တွေ့ရှိခဲ့ရသည်။ ရေဒီယိုကာဗွန် သက်တမ်းအရ ဘီစီ(၇၀၀)မှ ဘီစီ(၁၀၀)အတွင်း ထွန်းကားခဲ့သည် ဟု သတ်မှတ်ခဲ့ကြသည်။ (စိန်မောင်ဦး၊ ဦး၊ ၂၀၁၃၊ စာ-၈)

တကောင်း၊ သရေခေတ္တရာ၊ ပျူနိုင်ငံတော်ကြီး ပျက်သုဉ်းသွားပြီး နောက် အေဒီ ၁၀၄၄ တွင် အရိမဒ္ဒနပူရခေါ် ပုဂံနေပြည်တော်ကြီးကို ဗဟိုပြုလျက် အနော်ရထာ မင်းကြီးသည် ပထမ မြန်မာနိုင်ငံတော်ကြီးကို တည်ထောင်ခဲ့သည်။ ပျူနိုင်ငံတော်ကြီး ပျက်သုဉ်းပြီး ပုဂံမင်းနေပြည်တော် ပေါ်လာ သော်လည်း ခေါင်းလောင်း လှူဒါန်းသည့် ဓလေ့မှာ ဆက်လက်ရှင်သန်ဆဲ ဖြစ်သည်။

ခေါင်းလောင်းကိုယ်ထည် ပထမဖောင်းရစ်နှင့် ဒုတိယဖောင်းရစ်တို့တွင် ကမ္ပည်းစာ များကို ဘာသာစကား အမျိုးမျိုးဖြင့် ရေးထိုးခဲ့ကြသည်။ ရခိုင်ပြည်နယ် ဝေသာလီမြို့ဟောင်း အနီး ပြိုင်းထောင်း ကျေးရွာမှ (ခရစ်နှစ်-၁၉၁၈) တူးဖော်ရရှိသော အလေးချိန် တစ်ပေါင်ခန့်ရှိ ကြေးခေါင်းလောင်းမှာ- ကမ္ပည်းစာတန်းပါသော အစောဆုံး ကြေးခေါင်း လောင်းတစ်လုံး ဖြစ်မည်ဟု

ယူဆရပါသည်။ ထိုခေါင်းလောင်းသည် အမြင့် ၁၁.၈ စင်တီမီတာ၊ အောက်ခြေ အချင်း ၁၀.၅ စင်တီမီတာ၊ ခေါင်းလောင်းထု ၁ စင်တီမီတာ ရှိသည်။ ယင်းခေါင်းလောင်း၏ ပတ်လည်တွင် ကမ္ဘည်းစာတန်း နှစ်ကြောင်းရေးထိုးထားသည်။ အိန္ဒိယနိုင်ငံ ကမ္ဘည်းကျောက်စာ ဌာနမှ ပညာရှင် ခရစ်ချ်နားရှပ်စ်ထရီက သင်္သကရိုက်ဘာသာ ရောနှောနေကြောင်း၊ အေဒီ ခုနစ်ရာခန့်တွင် ရေးထိုးခဲ့ကြောင်း မှတ်ချက်ပေးခဲ့ပါသည်။ အက္ခရာ အသွင်သဏ္ဌာန်ကို လေ့လာ သောပညာရှင် များက နီတိစန္ဒြမင်းဆက် အဦးပိုင်း(သို့မဟုတ်) နီတိစန္ဒြ မင်းဆက် မတိုင်မီ အေဒီ ၅၂၀ ခန့်တွင် ရေးထိုးခဲ့ဟန် တူသည်ဟု မှတ်ချက်ပေးကြသည်။

ယင်းခေါင်းလောင်းတွင်

“ဤအရာဝတ္ထုသည် ဘုန်းတော်ကြီး၏ ရိုသေလေးမြတ်စွာပြုပါသော အလှူဒါန ဖြစ်ပါ၏။ ဤသို့ပြုရသော ကောင်းမှုကြောင့် ဆရာသမားများနှင့် တကွ သတ္တဝါ အားလုံးတို့သည် အကျွန်ုပ်၏ မိဘများနှင့်တကွ နိဗ္ဗာန်ချမ်း သာကို ရကြပါစေ သတည်း” (စိန်မောင်ဦး၊ ဦး၊ ၂၀၁၃၊ စာ-၁၄) ဟု အဓိပ္ပာယ်ရသော ကမ္ဘည်း စာတန်းကို ရေးထိုး ထားသည်။

ခရစ်နှစ် ၁၉၆၆ခုနှစ်တွင် ရခိုင်ပြည်နယ်၊ ဝေသာလီမြို့၊ ဟောင်း၏ အနောက်တောင်ဘက်၊ အပြင် မြို့ရိုး အနီး ဓာတ်တော် စေတီမှလည်း ကမ္ဘည်းစာတန်းပါ ခေါင်းလောင်းတစ်လုံးကို တွေ့ ရှိခဲ့ရသည်။ အိန္ဒိယနိုင်ငံ ရှေးဟောင်း သုတေသနဌာန၏ ခန့်မှန်းချက်အရ အေဒီ ၆ ရာစု ဂုဗ္ဗ ခေတ် အက္ခရာ အရေးအသား သင်္သကရိုက်ဘာသာဖြင့် ရေးထိုးထားသော ခေါင်းလောင်းတစ်လုံး ဖြစ်ကြောင်း သိရှိခဲ့ရပါသည်။

ပါဠိဘာသာဖြင့် ရေးထိုးထားသော ခေါင်းလောင်းစာကို ပုဂံ၊ မြင်ကပါးရပ်၊ တာမဏီ ကျေးရွာတွင် တွေ့ရှိခဲ့ရသည်။ ယခုအခါ အမျိုးသားပြတိုက်တွင် ထိန်းသိမ်းပြသထားပါသည်။ အမြင့် ၅.၅ လက်မ၊ အဝအကျယ် ၅.၂၅ လက်မရှိပြီး လက်ကိုင်တပ်(ကလိုင်) ခေါင်းလောင်းငယ် တစ်လုံးဖြစ်သည်။ ခေါင်းလောင်းကိုယ်ထည်တွင် ပါဠိဘာသာဖြင့်

“ထောယတဗ္ဗ လိင်္ဂသာဇိန သာသန စာရိနော အာရာမော တနေစေတေျ ဃဏ္ဍံ ပူဇေတိ သတ္တုနော အမင်္ဂါရာမေန သာသနတ္ထမ္မ ကောနရော”
(အမင်္ဂါအမည် အားဖြင့် သာသနာတော်ကို ထောက်ပံ့တတ်သော ပုဂ္ဂိုလ် သည် မြတ်စွာဘုရား သာသနာတော်ကို ဆောင်သော အရံ၌ ဝါနေစေတီ၌ ခေါင်းလောင်း ကို ပူဇော်သည်။)

ဟု မှတ်တမ်းတင်ထားပါသည်။ ပုဂံခေတ်မတိုင်မီ ရခိုင်ဝေသာလီနှင့် သရေခေတ္တရာ ပျူတို့၏ လက်ရာ ခေါင်းလောင်းကိုယ်ထည်မှာ သေးငယ်၍ထူထည် (အလေးချိန်) ကြီးကြီးမားမား မရှိခဲ့ပေ။ ထူထည်ကြီးမားသော ကြေးခေါင်းလောင်းများ သွန်းလုပ်လှူဒါန်းခြင်းကို ပုဂံခေတ် ရောက်မှသာ ထင်ထင်ရှားရှား တွေ့လာရပါသည်။(ပုံ၊ ၉)



(ပုံ)ဇုပုဂံ၊ မြင်ကပါးရပ်၊
တာမဏီအုတ်ကျောင်း
အရှေ့ဘက်မှရရှိသည်။
အေဒီ ၁၁ - ၁၃ ရာစုကြေးခေါင်းလောင်း

ခေါင်းလောင်းအလှူနှင့် စပ်လျဉ်း၍ ဦးကုလား၏ မဟာရာဇဝင်တော်ကြီး ပထမအုပ်၌ ကျန်စစ်သား မင်းကြီးသည် ညောင်ဦးရွှေစည်းခုံနှင့် ပုဂံအာနန္ဒာစေတီတို့ကို တည်တော်မူပြီး နောက်

“ ကြေးစင် ငါးထောင်သွန်းသော ခေါင်းလောင်းငါးလုံးတို့ကိုလည်း ရွှေစည်းခုံ ဘုရားမှာ သုံးလုံး၊ အာနန္ဒာဘုရားမှာ တစ်လုံး၊ မင်းအို ချမ်းသာဘုရားမှာ တစ်လုံး လှူတော်မူ၏” (ကုလား၊ ဦး၊ မ-၁၂၈၇၊ စာ-၂၁၈)

ဟု မှတ်တမ်းတင်ထားသည်။ မြန်မာသက္ကရာဇ် ၅၅၉(အေဒီ-၁၁၉၇)ခုထိုး သူဌေးမုခ် ဂူဘုရား ကျောက်စာတွင်

“ခေါင်လောင်” (က-၁၀)

မြန်မာသက္ကရာဇ် ၅၉၉(အေဒီ-၁၂၃၇)ခုထိုး ဉာဏပိစည်း ကျောက်စာတွင်

“ခေါင်လောင်ကြိယံ အပိသာ ၁၀၆ ပိသာ

ခွယ်အေ ။ သွန်အေ ” (က-၉)

မြန်မာသက္ကရာဇ် ၁၁၅၈(အေဒီ-၁၇၉၆)ခုထိုး ပုခန်းကြီးမြို့ စည်သူရှင်စေတီ ခေါင်းလောင်း စာတွင်

ကြေးစင်အကိန်း“ ၁၅၀၀၀ ရှိသောခေါင်းလောင်း

စည်နှင့်တကွ “

ဟူသော ကမ္မည်းမှတ်တမ်းများအရ ခေတ်အဆက်ဆက် အသံအလှူအဖြစ်ခေါင်းလောင်း လှူဒါန်းသည့်ဓလေ့ ဆက်လက်ထွန်းကားခဲ့ကြောင်း တွေ့ရှိရသည်။

ယခုအခါ ပုဂံခေတ် ရှေးဟောင်းအမွေလက်ရာ စေတီပုထိုး၊ ဂူကျောင်းစသည့်တို့ကို အများအပြား တွေ့ရှိရသော်လည်း ခေါင်းလောင်းများကိုမူ အနည်းအကျဉ်းသာ တွေ့ရှိခဲ့ရသည်။ ပုဂံသဗ္ဗညုဘုရားကြီး အရှေ့တောင်ဘက်တွင် ခေါင်းလောင်းချိတ်ဆွဲထားခဲ့သည်ဟု ယူဆရသော အုတ်တိုင်ကြီးနှစ်တိုင်ရှိသော်လည်း ခေါင်းလောင်းကိုမူမတွေ့ရပေ။ ထို့ပြင် ကျန်စစ်သားမင်း ကြီးသည် ညောင်ဦးရွှေစည်းခုံနှင့် ပုဂံအာနန္ဒာ စေတီတို့ကို တည်တော်မူပြီးနောက် ရွှေစည်း ခုံဘုရားမှာ သုံးလုံး၊ အာနန္ဒာဘုရားမှာတစ်လုံး၊ မင်းအိုချမ်းသာ ဘုရားမှာတစ်လုံး လှူတော်မူ၏ ဟု ဦးကုလား၏

မဟာရာဇဝင်တော်ကြီး ပထမတွဲ(မ-၁၂၈၇၊ စာ ၂၁၈) ၌ မှတ်တမ်းတင်ထား သော်လည်း ယခုအခါ ညွှန်ပြစရာ ခေါင်းလောင်းကိုမူ မတွေ့ရှိခဲ့ရတော့ပေ။

(ပဲခူး) ဟံသာဝတီပြည့်ရှင် ရှင်စောပု၏ အမွေဆက်ခံသော ရာဇာဓိပတိ (ဓမ္မစေတီ) မင်းသည် ရွှေတိဂုံဘုရားပေါ်တွင် ကြေးပိဿာချိန် တစ်သိန်းရှစ်သောင်းရှိသော ကြေး ခေါင်းလောင်းကို ခရစ်နှစ် (၅.၂.၁၄၈၄) တွင် လှူဒါန်းခဲ့ပါသည်။ ခရစ်နှစ် ၁၅၈၂ခုနှစ် (မြန်မာသက္ကရာဇ် ၉၄၄)တွင် ရွှေတိဂုံ စေတီတော်သို့ ရောက်ရှိခဲ့သူ အီတလီလူမျိုး ကျောက်မျက် ရတနာကုန်သည် ဂတ်စ်ပါရိဘယ်ဘီက ရွှေတိဂုံဘုရားအကြောင်းကို အသေးစိတ်မှတ်တမ်းတင် ခဲ့သည်။ ထိုမှတ်တမ်း ထဲတွင် ဓမ္မစေတီ ခေါင်းလောင်းကြီးနှင့်ပတ်သက်၍

“ကျွန်ုပ်တွေ့ခဲ့ရသည်မှာ အလွန်ခမ်းနားသော ခန်းမကြီးထဲတွင် အလွန်အလွန်ကြီးမား သော ခေါင်းလောင်းကြီးရှိပြီး အတိုင်းအတာအားဖြင့် ခြောက်လှမ်းနှင့်သုံးဖန်ရှိပြီး အထက်မှ အောက်သို့ စာလုံး တစ်ခုနှင့်တစ်ခု ပူးကပ် နေသောစာများ အပြည့်ရေးထားပြီး ဖတ်ရမည့်ပုံ မပေါ်ပေ”ဟု ဖော်ပြထား သော်လည်း ခရစ်နှစ် ၁၆၀၈ (မြန်မာသက္ကရာဇ် ၉၇၄-ခုတန်ဆောင်မုန်းလပြည့်နေ့၊ တနင်္ဂနွေနေ့) နေ့လယ်၁၂နာရီတွင် သံလျင်မြို့စား ပေါ်တူဂီ လူမျိုး ဖိလစ်ဒီဘရစ်တို (ခေါ်) ငဇင်ကာ ၏ မတော်လောဘကြောင့် ရန်ကုန်မြို့နှင့် သံလျင်မြို့ကြား ပဲခူးမြစ်နှင့် ရန်ကုန်မြစ်ဆုံရာ ဒေါပုံမြစ်ထဲသို့ ကျရောက် ခဲ့ရသည်ဟု အဆိုရှိပါသည်။ (Great Bell of Dhammazedī. From [https:// my. m. wikipedia. org/ wiki/ special:](https://my.m.wikipedia.org/wiki/special:))

အကြောင်း အမျိုးမျိုးကြောင့် မြန်မာ့ခေါင်းလောင်းများ ပျောက်ပျက်ခဲ့သော်လည်း မျက်မြင် တွေ့နိုင်သော ထင်ရှားသည့် ခေါင်းလောင်းများလည်း ရှိပါသေးသည်။ မြန်မာနိုင်ငံတွင် အကြီးဆုံးစာရင်းဝင် ဗဒုံမင်း (ခေါ်) ဘိုးတော်ဘုရား၏ ကောင်းမှုတော် မင်းကွန်းခေါင်းလောင်း၊ ရွှေတိဂုံစေတီရင်ပြင်ရှိ ဃဏ္ဍာ ခေါ် (စဉ့်ကူးမင်း ခေါင်းလောင်း၊ သာယာဝတီမင်း၏ မဟာတိ သဒ္ဓဃဏ္ဍာ ခေါ်) သာယာဝတီမင်းခေါင်းလောင်းတို့မှာ ထင်ရှားသော ခေါင်းလောင်းများ ပင်ဖြစ်သည်။ ထို့ပြင် မင်းတုန်းမင်း၏ ကောင်းမှုတော် “မဟာဂီရိမကုဋ ဃဏ္ဍရာဇာ” ခေါင်း လောင်းနှင့် ပုဂံမင်း ကောင်းမှုတော် ခေါင်းလောင်းကို မန္တလေးမြို့ အိမ်တော်ရာ ဘုရားရင်ပြင်၌ တွေ့နိုင်ပါသည်။ ဘကြီးတော်နှင့် မိဖုရားခေါင်ကြီး၏ ကောင်းမှုတော် “မဟာမေရုကဋ ဃဏ္ဍရာဇာ” ခေါင်းလောင်းကို အမရပူရမြို့ ပုထိုးတော်ကြီး စေတီရင်ပြင်၌လည်းကောင်း အလောင်း မင်းတရားကြီး၏ ခေါင်းလောင်းကို ရွှေဘိုမြို့ ရွှေချက်သိုဘုရား ပုရပုဏ်အတွင်း၌ လည်းကောင်း တွေ့ရှိနိုင်ပါသေးသည်။

ခေတ်အဆက်ဆက် သွန်းလုပ်ခဲ့သော အချို့သောမြန်မာမှု လက်ရာကြေးခေါင်းလောင်း များကို ကိုလိုနီနယ်ချဲ့တို့သည် သိမ်းယူဖျက်ဆီးခြင်း၊ အရည်ကျိုခြင်း၊ အမြောက်လက် နက်များ ပြုလုပ်ခဲ့ခြင်း စသည့် အဖျက်လုပ်ငန်းများ ပြုလုပ်မှုရှိခဲ့ပါသည်။ ထို့ကြောင့် အဆိုပါခေါင်း လောင်းများသွန်းလုပ်သည့် ပန်းတဦး အတတ်ပညာ မြန်မာ့ယဉ်ကျေးမှု အမွေအနှစ်လက် ရာများ ဆုံးရှုံးခဲ့ရသည်။ ထို့ပြင် သရေခေတ္တရာ ပျူခေတ်ကတည်းမှစ၍ ခေတ်အဆက်ဆက် ခေါင်းလောင်း သွန်းလုပ်လှူဒါန်းခြင်း အလေ့အထ ရှိခဲ့သော်လည်း ယနေ့ခေတ်တွင် ထိုအလေ့အထ နည်းပါး လာသည်ကို တွေ့ရသည်။

မည်သို့ပင်ဖြစ်စေ ဗုဒ္ဓသာသနာ စည်ပင်ထွန်းကားရာ အဓိမြန်မာနိုင်ငံတွင် ခေါင်းလောင်းသံ တည်ညံ့ဖြင့် အမျှဝေသံတို့ ယနေ့ထက်တိုင် ဝေစည်လျက်ပင် ရှိနေပါသေးသည်။

သုံးသပ်ချက်

ပြည်မြို့သရေခေတ္တရာမြို့ဟောင်း ရွှေတံခါးအပိုင်း၃ ဦးမောင်မောင်လွင် ခြံဝင်းအတွင်း၌ တွေ့ရသော ဝိဇယ မိုးကြိုးသွားလေးနှင့် နတ်မင်းမျက်နှာပါရှိသော ကြေးခေါင်းလောင်း၊ ပြည်မြို့သရေခေတ္တရာ မြို့ဟောင်း မှော်ဇာရှိ ဘုရားမာ(သရမာ) စေတီကုန်းအမှတ်(၈)မှ တူးဖော်ရရှိသော ပျူခေတ် ဒင်္ဂါးများတွင် ပါလေ့ရှိသော သီရိဝိဇယတံဆိပ်ပါ အပြောက်အမွမ်း ခြယ်ထားသော ခေါင်းလောင်းများ အရ မြန်မာနိုင်ငံတွင် ခေါင်းလောင်း သွန်းလုပ်သည့် ပန်းတဦးအတတ် ပညာသည် ပျူခေတ် (အေဒီ ၄ရာစု) ကတည်းက ရှိနေခဲ့ပြီဖြစ်ကြောင်း သိရပါသည်။ အဆိုပါ ခေါင်းလောင်းများတွင် ကမ္ဘည်းစာများမပါရှိပေ။

ရခိုင်ပြည်နယ်၊ ဝေသာလီမြို့ဟောင်း အနီး ပြိုင်းထောင်းကျေးရွာမှ တူးဖော်ရရှိသော ကြေးခေါင်းလောင်း၊ ရခိုင်ပြည်နယ် ဝေသာလီမြို့ ဟောင်း၏ အနောက်တောင်ဘက်မြို့ရိုးအနီး ဓာတ်တော်စေတီမှ တွေ့ရှိခဲ့ရသော ကြေးခေါင်းလောင်းများနှင့် ပုဂံမြင်ကပါးရပ်ရှိ တာမဏီ ကျေးရွာမှ တွေ့ရှိခဲ့ရသော ကြေးခေါင်းလောင်းအရလည်းကောင်း မြန်မာသက္ကရာဇ် (၅၅၉) ခုနှစ်ထိုး သူဌေးမုခ်ဂူ ဘုရားကျောက်စာနှင့် မြန်မာသက္ကရာဇ် (၅၉၉) ခုနှစ်ထိုး ဉာဏပိ စည်းကျောက်စာ များအရ မြန်မာနိုင်ငံတွင် အေဒီ ၅ ရာစုခန့်ကတည်းက ခေါင်းလောင်း များပေါ်တွင် အလှူမှတ်တမ်း ကမ္ဘည်းစာများ စတင်ရေးထိုးလာကြောင်းတွေ့ရပါသည်။

နိဂုံး

ခေါင်းလောင်း ကမ္ဘည်းစာများသည် မြန်မာတို့၏ လူနေမှုဘဝ၊ ယဉ်ကျေးမှု၊ ဘာသာရေးနှင့် စာပေအခြေအနေတို့ကို ဖော်ထုတ်ပေးနိုင်သော ရှေးဟောင်းစာပေလက်ရာတစ်ခုဖြစ်ပါသည်။ မြန်မာ့အနုပညာ လက်ရာ ပန်းတဦး ပညာကိုလည်း ဖော်ထုတ်ရာရောက်ပါသည်။ ယဉ်ကျေးမှု အနုပညာလက်ရာများနှင့် စာပေများကို တိမ်ကောပျောက်ကွယ်မှု မရှိစေရန် ထိန်းသိမ်းကာကွယ် ဖော်ထုတ်ပေးရန်မှာ နိုင်ငံသားတိုင်း၏ တာဝန်တစ်ရပ်ပင်ဖြစ်ပါသည်။ ဤစာတမ်းသည် ရှေးဟောင်း စာပေလေ့လာလိုသူများအတွက် ယခုထက်ပို၍ အသေးစိတ်ဆက်လက်သုတေသန ပြုနိုင်ရန် တစ်ဖက်တစ်လမ်းမှ အထောက်အကူဖြစ်စေမည်ဟု ယုံကြည်မိပါသည်။

ကျမ်းကိုးစာရင်း

မြန်မာဘာသာ

ကုလား၊ ဦး။ ။(၁၂၈၇-မ)မဟာရာဇဝင်တော်ကြီး (ပ တွဲ)။ ရန်ကုန်၊ မြန်မာသုတေသနအသင်း။

ကုလား၊ ဦး။ ။(၁၉၆၀)မဟာရာဇဝင်တော်ကြီး(ဒု တွဲ) ။ ရန်ကုန်၊ ဟံသာဝတီပုံနှိပ်တိုက်။

ကိုကို(၂၀၀၁) ။(သုတေသန) ။ကုန်းဘောင်တော်ဝင်ကမ္ဘည်းတင်ခေါင်းလောင်းများ ။ ရန်ကုန်၊ စာပေဗိမာန်။

ကျော်ဒင်ဟန်၊ ဦး။ ။(၂၀၀၀)ရွှေဆံတော်ဘုရားသမိုင်းကြောင်း ။ ပြည်မြို့၊ ရွှေဆံတော်စေတီတော် မြတ်ကြီး ဂေါပကအဖွဲ့ရုံး။

ကြန်၊ မ။ ။(၂၀၀၂) **သမိုင်းရှာပုံတော်ခရီးနှင့် အခြားစာတမ်းများ** ။ ရန်ကုန်၊ သုခပုံနှိပ်တိုက်။

ရှေးဟောင်းမြန်မာကျောက်စာများ ၊ ပထမတွဲ ။ ။ ရန်ကုန်၊ (ဖတ်ရှုရေးသားစီစဉ်သူ ဦးငြိမ်းမောင်) ။(၁၉၇၂)
ရှေးဟောင်းသုတေသနဦးစီးဌာန။

ရှေးဟောင်းမြန်မာကျောက်စာများ ၊ ဒုတိယတွဲ ။ ။ ရန်ကုန်၊ (ဖတ်ရှုရေးသားစီစဉ်သူ ဦးငြိမ်းမောင်) ။(၁၉၈၂)
ရှေးဟောင်းသုတေသနဦးစီးဌာန။

ရှေးဟောင်းမြန်မာကျောက်စာများ ၊ တတိယတွဲ ။(၁၉၈၃)။ ရန်ကုန်၊ (ဖတ်ရှုရေးသားစီစဉ်သူ ဦးငြိမ်းမောင်)။(၁၉၈၃)
ရှေးဟောင်းသုတေသနဦးစီးဌာန။

ရှေးဟောင်းမြန်မာကျောက်စာများ ၊ ဆဋ္ဌမတွဲ ။ ။ ရန်ကုန်၊ (ဖတ်ရှုရေးသားစီစဉ်သူ ဦးငြိမ်းမောင်) ။(၂၀၁၃)
ရှေးဟောင်းသုတေသနဦးစီးဌာန။

စာပေဗိမာန်။ ။(၁၉၉၅) **မြန်မာ့စွယ်စုံကျမ်းအတွဲ ၂ (ခုံ-ကျ)** ။ ရန်ကုန်၊ မြန်မာနိုင်ငံဘာသာပြန် စာပေအသင်း။

စိန်မောင်ဦး၊ ဦး။ ။(၂၀၁၃) **မြန်မာနိုင်ငံလက်ရွေးစင်ရှေးဟောင်းခေါင်းလောင်းစာများ** ။ ရန်ကုန်၊ ရှေးဟောင်းသုတေသနနှင့်
အမျိုးသားပြတိုက်ဦးစီးဌာန။

ဘုန်းတင့်ကျော်။ ။(၂၀၁၀) **နှစ်ပေါင်းနှစ်ထောင်ကျော်ခဲ့ပြီဖြစ်သော မြန်မာ့သမိုင်း** ။ ရန်ကုန်၊ ကံ့ကော်ဝတ်ရည်စာပေ။

မြမြချို၊ မ။ ။(၂၀၁၀) **ရှေးဟောင်းမွန်ခေါင်းလောင်းစာမှ လေးနက်ခိုင်မာသည့် စံပြဖွယ်စာပေ အထောက်အထားများ** ။
ရန်ကုန်၊ ထွန်းဖောင်ဒေးရှင်းဘဏ်စာပေကော်မတီ။ သီတာပုံနှိပ်တိုက်။

မြန်မာစာအဖွဲ့။ ။(၂၀၀၈) **မြန်မာအဘိဓာန်(ဒုကြိမ်)** ။ ရန်ကုန်၊ မြန်မာစာအဖွဲ့ပုံနှိပ်ထုတ်ဝေရေး၊ နေလင်းပုံနှိပ်တိုက်။

မြန်မာစာအဖွဲ့။ ။(၂၀၁၆) **မြန်မာသဒ္ဒါ(တကြိမ်)** ။ ရန်ကုန်၊ မြန်မာစာနှင့် ဘာသာစကားပညာရေး ဦးစီးဌာန။

ယဉ်ယဉ်မွန် ။(၂၀၁၄) ။(ရှေးဟောင်းသုတေသန) **ဟံသာဝတီခေတ် မွေစေတီမင်းကြီး၏ ကောင်းမှုတော်များ** ။ ရန်ကုန်၊
စာပေဗိမာန်။

လှိုင်ဝင်းဆွေ။ ။(၂၀၁၂) **မြန်မာ့ခေါင်းလောင်း(ဒုကြိမ်)** ။ ရန်ကုန်၊ စိတ်ကူးချိုချိုစာပေ။

လှိုင်ဝင်းဆွေ။ ။(၂၀၁၄) **ရှေးဟောင်းကမ္ဘာဦးစာများ** ။ ရန်ကုန်၊ ဂျီတီစီပုံနှိပ်တိုက်။

သန်းထွန်း၊ ဒေါက်တာ။ ။(၂၀၀၂) **ခေတ်ဟောင်းမြန်မာရာဇဝင် (တကြိမ်)** ။ ရန်ကုန်၊ အင်းဝ စာအုပ်တိုက်။

ဟုတ်စိန်၊ ဦး။ ။(၁၉၅၄) **ပါဠိမြန်မာအဘိဓာန်** ။ ရန်ကုန်၊ ပြည်ထောင်စုမြန်မာနိုင်ငံတော်အစိုးရ စာပုံနှိပ်ရေးနှင့်
စာရေးကိရိယာဌာန။

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ကြေးမုံနှင့် မြန်မာ့အလင်းသတင်းစာများ သတင်းခေါင်းစီး

ဒေါ်ခင်နှင်းရီ*

စာတမ်းအကျဉ်း

ဤစာတမ်းသည် ကြေးမုံနှင့်မြန်မာ့အလင်းသတင်းစာများမှ သတင်း ခေါင်းစီး (၅)မျိုးကို ရေးဟန်ပညာရှုထောင့်မှ လေ့လာတင်ပြထားသော စာတမ်း ဖြစ်သည်။ လေ့လာ ရာတွင် သတင်းခေါင်းစီး (၅)မျိုးရှိကြောင်း ဖော်ထုတ် တင်ပြလိုသော ရည်ရွယ်ချက်ဖြင့် လေ့လာထားခြင်းဖြစ်ပါ သည်။ ထို့ကြောင့် ကြေးမုံနှင့် မြန်မာ့ အလင်း သတင်းစာများ(၂၀၁၀-၂၀၁၈) တို့ကို စာပေ လေ့လာခံ သုတေသန နယ်နိမိတ်အဖြစ် သတ်မှတ် ပြုစုထားပါသည်။ ဤစာတမ်းကို ရေးဟန်ပညာရေး နည်းစနစ်ဖြင့် ဘာသာစကား အသုံးပြုမှုရှုထောင့်မှ ချဉ်းကပ်လေ့လာ ပြုစုထားပါ သည်။ ဤစာတမ်း ပြုစုမှုသည် သတင်းအတတ်ပညာ လေ့လာမှုနှင့် ရေးဟန်ပညာ လေ့လာမှုတို့ အတွက် အထောက်အကူ ပြုစေပါသည်။

သေချာချက်ဝေါဟာရများ။

။သတင်းစာ၊ ရေးဟန်ပညာ၊ သတင်း ခေါင်းစီး၊ အခြေအနေ၊ လမ်းညွှန်မှု၊ ဆန္ဒပြု၊ ခန့်မှန်း၊ စိတ်ဝင်စားမှု။

၁။နိဒါန်း

ဤစာတမ်းသည် ခရစ်နှစ် ၂၀၁၀-၂၀၁၈ ခုနှစ်အထိ မြန်မာနိုင်ငံတွင်ပုံနှိပ်ထုတ်ဝေခဲ့သော နိုင်ငံပိုင် သတင်းစာများဖြစ်သည့် ကြေးမုံနှင့်မြန်မာ့အလင်းသတင်းစာများမှ အဓိကအပိုင်း ကဏ္ဍဖြစ်သော သတင်းခေါင်းစီးရေးဟန်ကို သုတေသနပြုဖော်ထုတ်လေ့လာတင်ပြသော စာတမ်းဖြစ်ပါသည်။ သတင်းခေါင်းစီးဟူသည် သတင်းတစ်ပုဒ်လုံး၏ အဓိကအသက် သွေးကြောဖြစ်ပါသည်။ ထို့ပြင် သတင်းတစ်ပုဒ်လုံး၏ အနှစ်ချုပ်လည်းဖြစ်သည်။ စာဖတ်သူက သတင်းခေါင်းစီးကို ဖတ်မိသည်နှင့် တစ်ပြိုင်နက် အောက်တွင်ဆက်လက်၍ ဖော်ပြမည့် သတင်း၏ အတိမ်အနက် အရေးပါမှု၊ မပါမှု၊ ပုံမှန်ဖြစ်မှု၊ မဖြစ်မှု၊ ထူးခြားဖြစ်စဉ် ဟုတ်၊ မဟုတ်တို့ကို သတင်းခေါင်းစီးတွင် အထင်အရှား တွေ့မြင် နိုင်ပါသည်။

ထို့ကြောင့် ဤစာတမ်း၌ သတင်းစာပါ သတင်းတိုင်းတွင် သတင်းခေါင်းစီး တပ်ပေးရပါ သည်။ သတင်းခေါင်းစီးသည် သတင်းတစ်ပုဒ်အတွက် အရေးပါသော အစိတ်အပိုင်းတစ်ခု ဖြစ်သည်။ သတင်းတစ်ပုဒ်လုံးကိုဖတ်ရန် အချိန်မပေးနိုင်သူများအတွက် သတင်းခေါင်းစီး သည် သတင်းစာ ဆိုလိုရင်းကို အချိန်တိုအတွင်း ပေးစွမ်းနိုင်ပုံတို့ကိုလည်း တင်ပြထား ပါသည်။ သတင်းစာတိုင်း၏ သတင်းခေါင်းစီးသည် စာဖတ်သူ၏စိတ်အာရုံကို ဆွဲဆောင်နိုင် စွမ်းရှိရမည်။ သတင်းကို ဆက်လက်ဖက်ရှုလိုစိတ်လည်း ဖြစ်ပေါ်လာစေရန် ဩဇာလွှမ်းမိုးမှု လည်းရှိရမည်။ သို့မှသာ သတင်းအပြင်အဆင်အတွက်လည်း အထောက်အကူပြုနိုင်ကြောင်း သုံးသပ် တင်ပြ ထားပါသည်။

ဤစာတမ်းတွင် သတင်းခေါင်းစီးများ သဘောသဘာဝကို ရှင်းလင်းဖွင့်ဆိုခြင်း၊ သတင်း ခေါင်းစီး (၅)မျိုးကို သတ်မှတ်ရှင်းပြခြင်းနှင့် ကြေးမုံနှင့် မြန်မာ့အလင်းသတင်းစာများမှ လည်း

* ညွှန်ကြားရေးမှူး၊ ကျောင်းပြင်ပနှင့်တစ်သက်တာပညာရေးဦးစီးဌာန

သတင်းခေါင်းစီး (၅)မျိုး၏ ရေးဟန်ကို လေ့လာစိစစ် တင်ပြခြင်းဟူ၍ ကဏ္ဍခွဲကာ လေ့လာတင်ပြထားပါသည်။

၂။ သတင်းခေါင်းစီးဟူသည်

ကြေးမုံနှင့် မြန်မာ့အလင်းသတင်းစာများသည် နိုင်ငံတော်အစိုးရပိုင် သတင်းစာများ ဖြစ်သည်။ နိုင်ငံတော်ပိုင် သတင်းစာများဖြစ်သောကြောင့် ပြည်သူလူထု လက်ခံနိုင်အောင် ပညာသား ပါပါဖြင့် ဝါဒဖြန့် လှုံ့ဆော်စည်းရုံးပြီး သတင်း၏အနှစ်သာရ (သို့မဟုတ်) အဓိက အကြောင်းအရာကို ပေါ်လွင်စေရန် သတင်းခေါင်းစီး တပ်လေ့ရှိသည်။ သတင်းခေါင်းစီးသည် သတင်း၏ အနှစ်ချုပ်ကို ပေါ်လွင်လျှင် သတင်းစာဖတ်သူအား သတင်းစာသားများက ဆက်လက် ဖတ်ရှုလိုချင်စိတ် ဖြစ်လာအောင် ဖိတ်ခေါ်ဆွဲဆောင်သွားနိုင်သည်။

သတင်းခေါင်းစီးတပ်ရာတွင် ဖတ်ရှုသူလွယ်ကူစွာ သဘောပေါက်စေသော စာလုံးများ အသုံးပြု၍ ရေးသားရမည်။ သတင်းခေါင်းစီးသည် အကြောင်းအရာပါ သတင်းကို အမျိုးသားရေး အမြင်ဖြင့် သုံးသပ်ကာ စည်းရုံးသော (သို့မဟုတ်) ဝါဒဖြန့်သော (သို့မဟုတ်) လှုံ့ဆော်သော သတင်းခေါင်းစီး စကားလုံးများ ရွေးချယ်တင်ရန် လိုအပ်ပါသည်။

ဝါဒဖြန့်၊ စည်းရုံး၊ လှုံ့ဆော်သည်ဆိုရာ၌ ပြည်သူလူထုလက်ခံနိုင်အောင် ပညာသား ပါပါဖြင့် လှုံ့ဆော်စည်းရုံးနိုင်ရမည်။ ထို့ကြောင့် နိုင်ငံတော်ပိုင် သတင်းစာများဖြစ်၍ သတင်းခေါင်းစီး တပ်ရာတွင် သတင်းစာသားများသည် အမျိုးသားအကျိုး စီးပွားအတွက် ဝါဒဖြန့်ရန် လိုအပ်ပါသည်။

၃။ သတင်းခေါင်းစီး၏ အဓိပ္ပာယ်နှင့် သဘောသဘာဝ

သတင်းခေါင်း၊ သတင်းခေါင်းစီး ဟူသော ဝေါဟာရသည် သတင်းခေါင်းစဉ်နှင့် အတူတူ ပင်ဖြစ်သည်။ သတင်းခေါင်း၊ သတင်းခေါင်းစီး ဟူသော ဝေါဟာရကို သတင်းစာလောကတွင် အသုံးပြုလေ့ရှိပြီး၊ ရုပ်မြင်သံကြားနှင့် ရေဒီယိုတို့တွင် သတင်းခေါင်းစဉ်ဟု သုံးနှုန်းလေ့ ရှိသည်။ သတင်းခေါင်းသည် သတင်းတစ်ပုဒ်လုံး၏ အရေးပါသော အစိတ်အပိုင်းတစ်ခု ဖြစ်သည်။ သတင်းတစ်ပုဒ်လုံးကို ဖတ်ရန် အချိန်မပေးနိုင်သူများအတွက် သတင်းခေါင်းစီး သည် သတင်း၏ ဆိုလိုရင်းကို အချိန်တိုအတွင်း သိရှိနိုင်သည်။ ထို့ကြောင့် သတင်းခေါင်းတပ် ရာတွင် စာဖတ်သူ၏ စိတ်အာရုံကို ဆွဲဆောင်နိုင်စွမ်း ရှိရမည်။ သတင်းခေါင်းစီးကိုကြည့်၍ သတင်းကို ဆက်လက်ဖတ်ရှုလို စိတ်လည်း ဖြစ်ပေါ်စေရမည်ဖြစ်သည်။

သတင်းခေါင်းစီးတပ်ခြင်းနှင့် ပတ်သတ်၍ တက္ကသိုလ်မြတ်သူ ကလည်း သတင်းခေါင်းစီး တပ်ပေးခြင်းဖြင့်-

- (၁) စာဖတ်သူအား မည်သည့်သတင်းဖြစ်ပွားကြောင်း သိသာစေသည်၊
- (၂) စာဖတ်သူ၏စိတ်အာရုံကို ဆွဲဆောင်နိုင်သည်၊
- (၃) သတင်းစာသားများကို ဆက်လက်ဖတ်ရှုလိုစိတ် ပေါ်လာအောင် ဖိတ်ခေါ်ပေးနိုင်သည်၊
- (၄) သတင်းစာကို ပိုမိုအသက်ဝင်စေသည်၊
- (၅) သတင်းစာအပြင်အဆင်အတွက် အထောက်အကူပြုစေသည်။

(၆) စာသားသက်သက်ချည်း ပိန်းပိတ်အောင် ထည့်သွင်းခြင်းထက် စာဖတ်သူအား ပိုမို အသက်ရှူချောင်စေသည်။

(၇) သတင်းစာဖတ်ချိန် မရလိုက်သူပင်လျှင် ခေါင်းစဉ်မြင်ရုံဖြင့် မည်သည့်သတင်းဖြစ်ပွားကြောင်း အမြဲကျ သိစေနိုင်သည်။

(၈) စာဖတ်သူအဖို့ မည်သည့်သတင်း အရင်ဖတ်ရမည်ကို အလွယ်ရွေးချယ်နိုင်စေသည်။¹

သတင်းခေါင်းစီးတပ်ခြင်းနှင့် ပတ်သက်၍ အခြေခံစည်းမျဉ်းစည်းကမ်းများကို သတင်းစာ ပညာ သင်တန်းစာအုပ်တွင် ဦးရဲမြင့်ဖေ၏သတ်မှတ်ချက်မှာ-

(က) သတင်း၏ အကျဉ်းအနှစ်သာရကို သတင်းဖတ်ပရိတ်သတ် သိရှိနိုင်စေရန်၊

(ခ) စာဖတ်သူတို့ ကြိုက်နှစ်သက်ရာသတင်းကို လွယ်ကူစွာ ရွေးချယ်ဖတ်ရှုနိုင်ရန်၊

(ဂ) သတင်းစာ အယ်ဒီတာ (သို့မဟုတ်) စာတည်းက သတင်းစာဖတ် ပရိတ်သတ်အတွက် သတင်း တန်ဖိုးကိုဖြတ်ပြီး ဖော်ပြပေးရန်၊

(ဃ) သတင်းစာဖတ်သူ၏ အာရုံကို စွဲဆောင်နိုင်ရန်၊

(င) သတင်းစာ၏ ကိုယ်ပိုင်ဟန်ကို ပေါ်လွင်စေရန်၊²

ဟူသော ရည်ရွယ်ချက်များ ထားရှိရပါသည်။ တစ်နည်းအားဖြင့် သတင်းခေါင်းစီးတပ်ခြင်း သည် အနုပညာဆန်သည်ဟု ဆိုရပါမည်။ သတင်းခေါင်းတပ်ရာတွင် သတင်းနှင့်စပ်လျဉ်း၍ တိတိကျကျ ရှင်းရှင်းလင်းလင်း ခိုးခိုးဒေါက်ဒေါက် ဖော်ပြနိုင်ရပါမည်။ လှုပ်ရှားမှုပါဝင်နိုင် ရပါမည်။ စကားလုံး မထပ်စေရ။ စကားလုံးများသည် လူသိနည်းသော စကားအသုံးအနှုန်း များကို ရှောင်ကြဉ်ရပါမည်။ ဆက်လက်၍ အခြေပြသတင်းစာပညာစာအုပ်တွင် ဂါးဒီးယန် ဦးစိန်ဝင်း ကလည်း-

“သတင်းခေါင်းစဉ်တပ်ရာတွင် သတင်းသဘောကို စာတစ်ကြောင်းဖတ်ရုံနှင့် သိနိုင်အောင် တပ်ရမည်။”³ ဟူ၍ မှတ်ချက်ပြုထားပါသည်။

အထက်ပါ ပညာရှင်များ၏ ဖွင့်ဆိုချက်များကို သုံးသပ်ရသော် သတင်းခေါင်းစီးသည် သတင်းစာ အနှစ်သာရမပါဘဲ မတပ်သင့်ပုံ သတင်း၏ အနှစ်သာရကို ထင်ဟပ်ပြီး တိကျမှန်ကန်မှု ရှိရမည်။ သတင်းခေါင်းစီးပါကျသည် ပစ္စုပ္ပန်ပြ ကြိယာကိုသာ အသုံးပြုပုံ သတင်းခေါင်းစီးသည် အနာဂတ်ကာလပြ ကြိယာအသုံးပြုပုံ၊ သတင်းခေါင်းစီးတွင် အဓိပ္ပာယ် နှစ်မျိုးရသော စကားလုံးများကို ရှောင်ကြဉ်ရပုံ၊ ခေါင်းစီးကို ဝါကျပုံစံဖြင့် သတင်းခေါင်းစီးတပ်ရပုံ၊ သတင်းခေါင်းစီး တိုင်းတွင် ကြိယာပါရှိပုံ၊ အချို့သော သတင်း ခေါင်းစီးတွင် ကာယကံရှင် ပြောစကား ရည်ညွှန်းချက်ကို ရည်ညွှန်းသော သတင်းခေါင်းစီး မျိုး ရှိပုံတို့ကို စိစစ် တွေ့ရှိ ရပါသည်။

¹ မြတ်သူ(တက္ကသိုလ်)၊ ၁၉၇၄၊ ၁၅၉

² ရဲမြင့်ဖေ ၊ သတင်းစာပညာသင်တန်း ၊ ၁၆၈

³ စိန်ဝင်း ၊ ဦး (ဂါးဒီးယန်း) ၊ သတင်းစာပညာသင်တန်း ၊ ၂၀

သတင်းစာများတွင် မိန့်ခွန်းနှင့် အင်တာဗျူး သတင်းများကို အခြေခံသော သတင်းခေါင်းစီးတပ်ရာ၌ ကာယကံရှင် ပြောစကား ရည်ညွှန်းချက်ကို ပြောင်းလဲမသုံးဘဲ ကာယကံရှင် ပြောသော စကားဖြင့် သတင်းခေါင်းစီး တပ်ခြင်းပြုရမည်။

အထက်ပါ လေ့လာတွေ့ရှိချက်များကို အခြေခံ၍ ကြေးမုံနှင့် မြန်မာ့အလင်းသတင်းစာ တို့မှ သတင်းခေါင်းစီးများ၏ သတင်းရေးဟန်ကိုလေ့လာလျှင် သတင်းခေါင်းစီးကို ဖတ်ရုံမျှ ဖြင့် သတင်းဖြစ်ရပ် တစ်ခုလုံး ခြုံငုံသိရှိနိုင်သည့် သတင်းခေါင်းစီးများလည်းရှိကြောင်း တွေ့ရပါသည်။

သတင်းခေါင်းစီး ရေးဟန်သည် သတင်း၏ အဓိကဆိုလိုချက် အကြောင်းအရာ အလေးပေးကာ အထိရောက်ဆုံး ဖော်ပြလေ့ရှိသည်။ တစ်နည်းအားဖြင့် သတင်း၏ အနှစ်ချုပ်ကို သတင်းခေါင်းစီး၌ ပေါ်လွင်အောင် အလေးပေး၍ သတင်းအကြောင်းအရာကို အလေးပေး ဖော်ပြလေ့ရှိသည်။ ၎င်းသတင်းခေါင်းစီးရေးဟန်ကို အကြောင်းအရာအလေးပေး သတင်းခေါင်းစီး ရေးဟန်ဟု ဆိုနိုင်ပါ သည်။

၄။ သတင်းခေါင်းစီး ရေးဟန်အမျိုးမျိုး

- (၁) အခြေအနေကို ဖော်ပြသည့် သတင်းခေါင်းစီးရေးဟန်၊
- (၂) လမ်းညွှန်အသိပေးမှုကိုဖော်ပြသည့် သတင်းခေါင်းစီးရေးဟန်၊
- (၃) ဆန္ဒကို အကြံပြုရေးသားဖော်ပြသည့် သတင်းခေါင်းစီးရေးဟန်၊
- (၄) ခန့်မှန်းသုံးသပ်မှုကို ဖော်ပြရေးသားသည့် သတင်းခေါင်းစီးရေးဟန်၊
- (၅) လူအများစိတ်ဝင်စေရန် ဖော်ပြရေးသားသည့် သတင်းခေါင်းစီးရေးဟန်တို့ ဖြစ်သည်။

၅။ ကြေးမုံနှင့် မြန်မာ့အလင်းသတင်းစာများမှ သတင်းခေါင်းစီးရေးဟန်

သတင်းခေါင်းစီးတပ်သော ခေါင်းစာလုံးပမာဏသည် မူလသတင်းစာ စာလုံးစာသား ထက် အရွယ်ပမာဏ ကြီးပေးရမည်။ သတင်းခေါင်းအမျိုးမျိုးရှိသည်။ သတင်းခေါင်းစီး တပ်ပုံကို လေ့လာသောအခါ သတင်းစာများ၏ ရှေ့မျက်နှာနှင့် ကျောအပေါ်ပိုင်း မျက်နှာစာ အဆင့် နှစ်ဆင့် သို့မဟုတ် သုံးဆင့်၊ လေးဆင့် စသည်ဖြင့် တပ်လေ့ရှိသည်။ ထိုသို့ အတွင်းစာမျက်နှာ ကို (၂) (၃) (၈) (၉) (၁၀) (၁၁) စသည်ဖြင့် အတွင်းစာမျက်နှာများသို့ သတင်းကူး ဖော်ပြသော ခေါင်း “ကူးခေါင်း” ဟုခေါ်သည်။ ကူးခေါင်းသည် နှစ်ကော်လံ၊ သုံးကော်လံ စသည်ဖြင့် တပ်လေ့ရှိသည်။

ဆက်လက်၍ သတင်းစာအောက်ပိုင်းနေရာ နှစ်ကော်လံ သို့မဟုတ် သုံးကော်လံ အပိုဒ်တို ဖြန့်စီးပြီး ဖော်ပြသော ခေါင်းစဉ်ကို ဖြန့်ခေါင်းဟူ၍ သတ်မှတ်ခေါ်ဆိုလေ့ရှိသည်။ သတင်းစာ စာမျက်နှာ ဖွဲ့စည်းရာတွင် သတင်းခေါင်းမှာ သတင်းတန်ဖိုးပေါ်မူတည်၍ သတင်းစာမျက်နှာ ပေါ်တွင် ဝါစဉ်အလိုက် သတင်းခေါင်းတပ်ရသည့် ရေးဟန်ဖြစ်ကြောင်း ကြေးမုံနှင့် မြန်မာ့အလင်း သတင်းစာများမှ သတင်းခေါင်းစီး ရေးဟန်အမျိုးမျိုးကို စိစစ် တင်ပြထား ပါသည်။

၅။ ၁။ အခြေအနေကိုဖော်ပြအသိပေးသည့် သတင်းခေါင်းစီးရေးဟန်

အခြေအနေကိုဖော်ပြအသိပေးသည့် သတင်းခေါင်းစီးရေးဟန်ဟူသည် သတင်းရေးသူ၏ စိတ်ခံစားမှု မပါခြင်း၊ သတင်းရေးသူ၏ ဝေဖန်သုံးသပ်အကဲဖြတ်ချက် မပါခြင်း၊ ထူးခြားသော ဝိသေသနများကို အတတ်နိုင်ဆုံး ရှောင်ရှားခြင်း စသည့် ဂုဏ်အရည်အသွေးများ ပါဝင်သည့် သတင်းရေးဟန်မျိုး ဖြစ်သည်။ တစ်နည်းဆိုရသော် အခြေအနေတစ်ခုကို ဖော်ပြမှုသက်သက် သာ ဖော်ပြသည့် သာမန် သတင်းရေးဟန်မျိုးဖြစ်ပါသည်။ သာဓကအားဖြင့် ယာဉ်တိုက်မှု တစ်ခုကို လာရောက်သတင်းယူသော သတင်းသမားသုံးဦး၏ သတင်းရေးဟန်ကို အောက်ပါ အတိုင်း တင်ပြထားပါသည်။

သာဓက-၁ လူငယ်တစ်ဦး ကားတိုက်ခံရ၍ သေဆုံးသွားခြင်း၊

သာဓက-၂ ယာဉ်မောင်းသူ၏ မဆင်မခြင် မောင်းနှင်မှုကြောင့် လူငယ်တစ်ဦး ကားတိုက်ခံရ၍ သနားစဖွယ် သေဆုံးသွားခြင်း၊

သာဓက-၃ စည်းကမ်းမဲ့စွာ လမ်းဖြတ်ကူသော လူငယ်တစ်ဦး ကားတိုက်ခံရ၍ သေဆုံးသွားခြင်း၊

အထက်ဖော်ပြပါ သာဓက သတင်းခေါင်းစီး သုံးခုအနက် သာဓက (၁) ပါ သတင်းခေါင်းစီး ရေးဟန်သည် အခြေအနေကို ဖော်ပြသည့် သတင်းရေးဟန် (သို့မဟုတ်) သာမန်သတင်းရေးဟန်မျိုး ဖြစ်ကြောင်း တွေ့နိုင်ပါသည်။

သာဓက(၂) နှင့် သာဓက (၃) တို့မှာမူ သတင်းစာဆရာ၏ စိတ်ခံစားချက်ပါဝင်ခြင်း၊ စကားအသုံးအနှုန်း၊ ဝိသေသ ထူးခြားချက်များ ပါဝင်ခြင်းတို့ ရှိနေကြောင်းကို တွေ့ရပါသည်။ အခြေအနေကို ဖော်ပြသည့် သတင်းရေးဟန်သည် ဝိသေသများ အဆင်တန်ဆာများ မပါဝင်ဘဲ အဖြစ်အပျက်ကို ပကတိအတိုင်းဖော်ပြသည့် ရေးဟန်မျိုးဖြစ်ခြင်းကြောင့် ဘက်လိုက်မှုကင်း သော ရေးဟန်ဟုလည်း ဆိုနိုင်ပါသည်။

အခြေအနေကို ဖော်ပြရေးသားသည့် သတင်းခေါင်းစီးရေးဟန်သည် နေ့စဉ်ထုတ် သတင်းစာ ဖြစ်သည့် ကြေးမုံနှင့် မြန်မာ့အလင်းသတင်းစာတို့တွင် အောက်ပါအတိုင်း တွေ့ရှိနိုင် ပါသည်။

“နိုင်ငံတော်အစိုးရ၏ စေတနာအမှန်ကို သိမြင် တောတွင်း လက်နက်ကိုင်အဖွဲ့ဝင်များ လက်နက်နှင့် ငြိမ်းချမ်းရေးဝင်ရောက်”⁴

“အပူချိန် မြင့်မားမှုကြောင့် သောက်သုံးရေ လိုအပ်ချက်များအပေါ် လူမှုဝန်ထမ်း ကယ်ဆယ်ရေးနှင့် ပြန်လည်နေရာချထားရေးဝန်ကြီးဌာနက ထောက်ပံ့ကူညီမှုများ ဆောင်ရွက်လျက် ရှိ”⁵

ဖော်ပြပါ သတင်းခေါင်းစီးများကို လေ့လာရာတွင် သတင်းဖြစ်ရပ်မှန်တစ်ခုကို စာဖတ်သူ တို့ အနေဖြင့် အချိန်တိုအတွင်း သိရှိစေရန် ရှင်းလင်းလွယ်ကူသော ရေးဟန်တို့ဖြင့် ရေးသားထား ကြောင်း တွေ့နိုင်ပါသည်။ သာဓကအဖြစ် ပါရှိသည့် သတင်းခေါင်းစီးများအားလုံးသည် ကြိယာ စာလုံး ပါဝင်အောင် ရေးသားတင်ပြထားကြောင်း တွေ့နိုင်ပါသည်။ “နိုင်ငံတော်အစိုးရ၏ စေတနာ

⁴ ကြေးမုံ၊ ၂၀၁၈၊ ဇူလိုင်လ၊ ၁ ရက်၊ ၁

⁵ မြန်မာ့အလင်း၊ ၂၀၁၆၊ ဩဂုတ်လ၊ ၁ရက်၊ ၁

အမှန်ကိုသိမြင် တောတွင်းလက်နက်ကိုင် အဖွဲ့ဝင်များ လက်နက်နှင့် ငြိမ်းချမ်းရေး ဝင်ရောက်” သည့် သတင်းတွင် “သိမြင်” လဲလှယ်ဝင်ရောက်” ဟူသော ပေါင်းစပ်ကြိယာ စကားလုံးနှစ်ခုကို သုံးထား ပါသည်။

“အပူချိန် မြင့်မားမှုကြောင့် သောက်သုံးရေ လိုအပ်ချက်များအပေါ် လူမှုဝန်ထမ်း ကယ်ဆယ်ရေးနှင့် ပြန်လည်နေရာချထားရေး ဝန်ကြီးဌာနက ထောက်ပံ့ကူညီမှုများ ဆောင်ရွက် လျက် ရှိ” ဟု ကြိယာ အထူးပြု စကားလုံးများနှင့် တွဲစပ် ရေးသားထားကြောင်း တွေ့နိုင်ပါသည်။ ထိုရေးဟန်ကြောင့်လည်း သတင်းအပေါ် စာဖတ်သူက စိတ်ဝင်စားမှုကို ပိုမိုရရှိစေပါသည်။ ထို့ကြောင့် အခြေအနေပြ သတင်းခေါင်းစီးရေးဟန်တွင် အခြေအနေတစ်ရပ်၏ လှုပ်ရှားမှု အနေအထားကို သတင်းခေါင်းစီးတွင် ပါဝင်သည့် ကြိယာစကားလုံးများက လုံးချင်းကြိယာနှင့် ပေါင်းစပ်ကြိယာ နှစ်မျိုးစလုံး အသုံးများသည် ရေးဟန်မျိုးဖြစ်ကြောင်း သိရှိရပါသည်။

၅၊ ၂။ လမ်းညွှန်သတိပေးမှုကို ဖော်ပြသော သတင်းခေါင်းစီး ရေးဟန်

လမ်းညွှန်သတိပေးမှုကို ဖော်ပြသော သတင်းခေါင်းစီးရေးဟန်သည် သတင်းရေးသူက သတင်းစာဖတ်သူကို လွှမ်းမိုး လမ်းညွှန်မှုနှင့် ဆိုင်သည့် သတင်းခေါင်းစီးရေးဟန်ဖြစ်သည်။ ၎င်းသတင်း ခေါင်းစီး ရေးသားရာတွင် ဘာသာစကားဖြင့် ရေးသားရသည်။ ဘာသာစကားသည် အနာဂတ်ကို လွှမ်းမိုးနိုင်စွမ်းရှိသည်။ မဖြစ်သေးသည်ကို ဖြစ်အောင် ပြုလုပ်နိုင်စွမ်း ရှိသည်ဟူသော အဆိုအတိုင်း သတင်းရေးသူက သတင်းဖတ်သူကို လမ်းညွှန်အသုံးပြုမှုဖြင့် မဖြစ်သေးသည်ကို ဖြစ်လာအောင် လမ်းညွှန်သတိပေးမှုကို ဖော်ပြနေသော သတင်းခေါင်းစီး ရေးဟန်များသည် နိုင်ငံတော်အစိုးရ၏ လမ်းညွှန်ချက်များ နိုင်ငံတော်အကြီးအကဲ၏ ဩဝါဒ မိန့်မှာချက်၊ တာဝန်ရှိသူများ၏ လမ်းညွှန် မှာကြားချက်များ၊ ဆွေးနွေးချက်များကို ကောင်နုတ်၍ သတင်းခေါင်းစီး တပ်ရာတွင် ၎င်းရေးဟန်ကို အသုံးပြုတတ်ပါသည်။ ထို့ပြင် သဘာဝ ဘေးအန္တရာယ်ဆိုင်ရာ သတင်းများ၊ ယာဉ်စည်းကမ်း လမ်းစည်းကမ်း ဆိုင်ရာ သတင်းများနှင့် သတင်းထုတ်ပြန်ချက်များကို ရေးသားဖော်ပြရာတွင် ၎င်းသတင်းခေါင်းစီးရေးဟန်ကို အသုံးပြု လေ့ရှိပါသည်။

သာဓကအားဖြင့်-

“မြန်မာ - ဂျပန် အသင်း၏ ပညာရည်ချွန်ဆု ဂျပန်နိုင်ငံ လေ့လာရေးခရီးစဉ် ၂၀၁၈ အတွင်း အဆိုပြုလွှာများ အချိန်မီတင်သွင်းကြရန် နှိုးဆော်”^၆

“အပူချိန် မြင့်မားမှုကြောင့် သောက်သုံးရေ လိုအပ်ချက်များအပေါ် လူမှုဝန်ထမ်း ကယ်ဆယ်ရေးနှင့် ပြန်လည်နေရာချထားရေး ဝန်ကြီးဌာနက ထောက်ပံ့ကူညီမှုများ ဆောင်ရွက်လျက်ရှိ”^၇

“အပူချိန်မြင့်မားမှုကြောင့် ငါးမွေးမြူရေးကန်များ ဆုံးရှုံးမှု စောင့်ကြည့်ရန် လို”^၈ “လိုင်စင်မဲ့

^၆ ကြေးမုံ ၂၀၂၈၊ ဇူလိုင်လ၊ ၃ ရက်၊ ၃

^၇ ကြေးမုံ ၂၀၁၈၊ ဇူလိုင်လ၊ ၁ ရက်၊ ၁၃

^၈ မြန်မာ့အလင်း ၂၀၁၅၊ မတ်လ၊ ၂ ရက်၊ ၂

ယာဉ်များကြောင့် ယာဉ်တိုက်မှု မကြာခဏဖြစ်၊ ထိရောက်စွာအရေးယူပေးနိုင်ရန် ဒေသခံများက လိုလား”⁹

ဟူ၍ နေ့စဉ်ထုတ် သတင်းစာများတွင် တွေ့ရှိရပါသည်။

အထက်ဖော်ပြပါ သာဓက(၂) နှင့် (၃) တို့သည် အပူချိန်မြင့်မားမှုအတွက် သောက်သုံးရေ လိုအပ်မှုကို လူမှုဝန်ထမ်း ကယ်ဆယ်ရေးနှင့် ပြန်လည်နေရာချထားရေးက သဘာဝ ဘေးအန္တရာယ် ဆိုင်ရာ လုပ်ငန်းများကို တာဝန်ယူဆောင်ရွက်နေပုံကို သတင်းခေါင်းစီးတပ်ကာ ရေးလေ့ရှိသည်။ ဆက်လက်၍ သာဓက (၄) ပါ သတင်းသည် ယာဉ်တိုက်မှုများ မကြာခဏ ဖြစ်ပွားရခြင်း အကြောင်း တရားများသည် လိုင်စင်မဲ့ယာဉ်များကြောင့် ဖြစ်လေ့ရှိသည်။ ထို့ကြောင့် ယာဉ်စည်းကမ်း၊ လမ်းစည်းကမ်းဆိုင်ရာ သတင်းများနှင့် သတင်းထုတ်ပြန်ချက် များကို ရေးသားဖော်ပြရာတွင် ယင်း သတင်းခေါင်းစီးရေးဟန်ကို သုံးစွဲလေ့ရှိသည်။

၅၊ ၃။ ဆန္ဒပြမှုကို ဖော်ပြအကြံပြုသည့် သတင်းခေါင်းစီးရေးဟန်

သတင်းရေးသူသည် လူထုနှင့် နီးစပ်သူများဖြစ်သဖြင့် လူထု၏အသံကို သတင်းစာတွင် အမြဲ ဖော်ပြလေ့ရှိသည်။ အထူးသဖြင့် ပြည်သူလူထု လိုအပ်ချက်များ ဖော်ပြသောအခါ ဆန္ဒပြမှုကို ဖော်ပြသည့် သတင်းခေါင်းစီးရေးဟန်ကို သုံးစွဲလေ့ရှိသည်။

သာဓကအနေဖြင့်-

“ရွှေဆိုင်းခေတ် လက်မှုလုပ်ငန်းများ ပျောက်ကွယ်ခြင်း မရှိစေရန် ဝိုင်းဝန်းထိန်းသိမ်း စောင့်ရှောက်ပေးစေလို”¹⁰

“ငါးသားရောက်မြို့နယ်၊ ခက်လန်းကန်ကျေးရွာတွင် ကျောင်းဆောင်သစ် ဆောက်လုပ် ပေးရန် လိုအပ်လျက်ရှိ”¹¹

“အန္တရာယ်ရှိသော လျှပ်စစ်ဓာတ်တိုင် အမြန်လဲလှယ်ပေးစေလို”¹²

ဖော်ပြပါ သာဓကပြု သတင်းခေါင်းစီးများသည် “လို” ဟူသော ကြိယာထောက် စကားလုံးကြောင့် တိုက်တွန်း အကြံပြုသည့်သဘော သက်ရောက်ပြီး “သင့်” သူသော ကြိယာထောက် စကားလုံးကြောင့် အကြံပြုသည့်သဘော သက်ရောက်စေပါသည်။ နေ့စဉ်ထုတ် သတင်းစာများသည် လူအများ လိုက်နာ ကျင့်သုံးလာစေရန် အသိပေးစည်းရုံးရေးဟန်မျိုးကို တွေ့ရှိရသည်။ သတင်း ခေါင်းစီးတွင် အသုံးပြုသော စကားလုံးများသည် စာဖတ်သူ နာလည်လက်ခံလွယ်သော စကားလုံးများ ဖြစ်ပြီး ပျော့ပြောင်းသော လေသံကြောင့် ပြည်သူတို့၏ ဆန္ဒကို ဖော်ပြအကြံပြုထားသည့် သတင်းခေါင်းစီးရေးဟန်နှင့် လိုက်ဖက်မှု ရှိသည်ဟု ဆိုရမည်ဖြစ်သည်။ သာဓက (၁) ပါ သတင်းခေါင်းစီးသည် နိုင်ငံတော်အကြီးအကဲများ၏ သက်ဆိုင်ရာ အခန်းအနားတွင် မိန့်ကြားချက်ကို ကောက်နုတ်၍ သတင်းခေါင်းစီး ရေးလေ့ ရှိသဖြင့် တိုက်တွန်းမှု လေသံပါနေကြောင်း တွေ့ရသည်။

⁹ မြန်မာ့အလင်း ၂၀၁၆၊ ဧပြီလ၊ ၂ ရက်၊ ၂

¹⁰ ကြေးမုံ ၂၀၁၈ ခုနှစ်၊ ဖေဖော်ဝါရီလ၊ ၇၊

¹¹ မြန်မာ့အလင်း ၂၀၁၆ ခုနှစ်၊ ဇူလိုင်လ၊ ၈၊

¹² မြန်မာ့အလင်း ၂၀၁၆ ခုနှစ်၊ ဩဂုတ်လ၊ ၂၂၊

တစ်နည်းဆိုရသော် ထိုခေါင်းစီး မျိုးသည် တိုက်တွန်းမှု လေသံထက် လမ်းညွှန်မှုလေသံ၊ အမိန့်ပေးမှုလေသံ ပိုဆန်နေကြောင်း တွေ့ရတတ်သည်။

၅၊ ၄။ ခန့်မှန်းသုံးသပ်မှုကို ဖော်ပြသည့် သတင်းခေါင်းစီးရေးဟန်

ခန့်မှန်းသုံးသပ်မှုကို ဖော်ပြသော သတင်းခေါင်းစီးရေးဟန်ဟူသည် သာမန်သတင်းရေး ဟန်မျိုး မဟုတ်ဘဲ သတင်းခေါင်းစီးသည် သတင်းရရှိမှု အခြေအနေ အတွေ့အကြုံတို့အပေါ် အခြေခံ၍ ဖြစ်ပေါ်လာသော သတင်းခေါင်းစီး မျိုးဖြစ်ပါသည်။ သတင်းရေးသူ၏ ခန့်မှန်း သုံးသပ်ချက် သည် စာဖတ်သူ ပြည်သူအပေါ် များစွာလွှမ်းမိုးမှု ရှိနိုင်ပါသည်။ ထိုခန့်မှန်းသုံးသပ် မှုကြောင့် လူထုအနေဖြင့် ကြိုတင်ပြင်ဆင်မှု အမျိုးမျိုးကို ဆောင်ရွက်နိုင်ပါသည်။ ခန့်မှန်း သုံးသပ်ချက်ကို ဖော်ပြသည့် သတင်းခေါင်းစီးများတွင် မိုးလေဝသသတင်းများ၊ ကုန်စည် စီးဆင်းမှုသတင်းများ၊ ကောက်ပဲသီးနှံ အထွက်နှုန်းသတင်းများ၊ ကူးဆက်ရောဂါ ဝေဒနာ အမျိုးမျိုးဆိုင်ရာသတင်းများ၊ ငွေကြေးစီးဆင်းမှုဆိုင်ရာသတင်းများ၊ ကမ္ဘာ့နိုင်ငံရေး အခြေအနေ သတင်းများ၊ အားကစား ပြိုင်ပွဲဆိုင်ရာ သတင်းများ စသည့် သတင်းအမျိုးမျိုးတို့၏ သတင်း ခေါင်းစီးမျိုးဟု ဆိုနိုင်ပါသည်။

ခန့်မှန်းသုံးသပ်မှုကို ဖော်ပြသော သတင်းခေါင်းစီးများတွင် ဖြစ်ပေါ်လာမည့် အခြေအနေကို နိမိတ်ပြ အသွင်ဆောင်နေပြီး ထိုသတင်းစာတိုင်း အမှန်တကယ် ဖြစ်ပေါ်လာ ပါက သတင်းစာ၏ ဂုဏ်ရည် မှာလည်း ပို၍ တက်လာမည်ဖြစ်သည်။

သာဓကအားဖြင့်-

“ရန်ကုန်မြို့နှင့် အနီးတဝိုက်တွင် မိုး တစ်ကြိမ် နှစ်ကြိမ် ထစ်ချုန်းရွာမည်ဟု ခန့်မှန်း”¹³

ဖော်ပြပါ သာဓကခေါင်းစီးများတွင် ပါဝင်သည့် ခန့်မှန်းသုံးသပ်ချက်သည် သတင်းရေးသူ၏ သတင်းရင်းမြစ် ခန့်မှန်းသုံးသပ်ချက်များသာ ဖြစ်ရာ သတင်းရေးဟန်၏ သဘောသဘာဝ အယူအဆကို မထိခိုက်နိုင်ပါ။ ခန့်မှန်းသုံးသပ်မှုကိုဖော်ပြသော သတင်းရေးဟန်ကြောင့် သတင်း အပေါ် စာဖတ်သူ၏ စိတ်ဝင်စားမှုကို ပိုမိုရရှိစေပါသည်။

၅၊ ၅။ လူအများ စိတ်ဝင်စားစေရန် ဖော်ပြသည့် သတင်းခေါင်းစီး ရေးဟန်

သတင်းတစ်ပုဒ်ဖတ်ရာတွင် စာဖတ်သူတို့သည် သတင်းခေါင်းစီးကို ဦးစွာဖတ်ကြသည် ဖြစ်ရာ သတင်းခေါင်းစီးသည် ဆွဲဆောင်မှုရှိရန် အရေးကြီးသည်။ သတင်းရေးသူသည် သတင်း စာဖတ်သူ စိတ်ဝင်စားဖွယ်ကောင်းသော သတင်းအချက်အလက် ထိထိမိမိပေးနိုင်အောင် သတင်းခေါင်းစီးဖြစ်ရန် အားထုတ်ကြသည်။ သတင်းစာအကြောင်းအရာပေါ်မူတည်၍ သတင်း ခေါင်းစီးကို တည်ငြိမ် ခန့်ညားအောင် ရေးသားသည့် သတင်းခေါင်းစီးရေးဟန်ရှိသကဲ့သို့ လူအများ စိတ်ဝင်စားစေရန် ဖော်ပြသည့် သတင်းခေါင်းစီးရေးဟန်လည်းရှိပါသည်။

သာဓကအနေဖြင့်-

“မြန်မာနိုင်ငံတွင် လာရောက်ရင်းနှီးမြှုပ်နှံရန် ငါးကန်စီးပွားရေး လုပ်ငန်းရှင်များအား တိုက်တွန်းမည်”¹⁴

¹³ ကြေးမုံ ၂၀၁၈ ခုနှစ်၊ ဖေဖော်ဝါရီလ၊ ၇၊

¹⁴ ကြေးမုံ ၂၀၁၅ ခုနှစ်၊ ဒီဇင်ဘာလ ၁ရက်၊ ၅၊

“စွန့်ပစ်ခံ မွေးကင်းစ ကလေးငယ်တစ်ဦး စောင့်ရှောက်ထား”¹⁵

“မြန်မာ - သင်္ကြန်ဖိုကိခရီးစဉ် ရုရှားချန်ပီယံ လက်ဝှေ့ကျော်နှစ်ဦး ပြန်လမ်းမလှခဲ့”¹⁶ ဖော်ပြပါ ကြေးမုံနှင့် မြန်မာ့အလင်းသတင်းစာပါ သတင်းခေါင်းစီးကို လေ့လာလျှင် မြန်မာနိုင်ငံ တွင် လက်ရှိအနေအထားအရ ကြီးမားသည့် ဈေးကွက်ကြီးတစ်ခု တည်ရှိနေပြီး ငါးကန် စီးပွားရေးလုပ်ငန်းရှင်များအား မြန်မာနိုင်ငံတွင် လာရောက် ရင်းနှီးမြှုပ်နှံရန် တိုက်တွန်းသွားမည် ဖြစ်ကြောင်း လူအများစိတ်ဝင် စားစေရန် ဖော်ပြရေးသည့် သတင်းခေါင်းစီးရေးဟန်ဖြင့် ရေးဖွဲ့ ထားရာ ပုံမှန်ဖြစ်ရိုးဖြစ်စဉ် သတင်းထောက် သတင်းစာဖတ်သူက ပိုမိုစိတ်ဝင်စားလာစေသည်။

အလားတူ သာဓက-၂ ပါ စွန့်ပစ်ခံ မွေးကင်းစ ကလေးငယ်တစ်ဦး စောင့်ရှောက်ထား သတင်းဖြစ်ရပ်မှာလည်း လူအများစည်ကားစွာဖြင့် တပ်ကုန်းမြို့နယ်လုံးဆိုင်ရာ မဟာဘုံကထိန် ပွဲတော်ကြီး ကျင်းပနေသည့် အချိန်တွင် ရန်ကုန် မန္တလေး ကားလမ်းဘေးမီးပွိုင့်အနီး၌ မွေးကင်းစ မိန်းကလေးငယ်တစ်ဦးအား နို့ပျော်ဘူး၊ ရေသန့်ဘူး၊ ဂွမ်းထုပ်၊ အင်္ကျီသုံးထည်၊ အနီးဖြူနှင့်အတူ မွေးကင်းစ ကလေးအား အနီးပတ်ထားပြီး သက်မဲ့ဥစ္စာပစ္စည်း စွန့်သကဲ့သို့ စွန့်ပစ်ခဲ့ပုံကို စိတ်ဝင်စား စေရန်၊ လူအများ စိတ်ဝင်စားစေရန် ဖော်ပြသည့် သတင်းခေါင်းစီး ရေးဟန် အသုံးပြုကြောင်း စိစစ်တွေ့ရှိရသည်။

ခြုံငုံသုံးသပ်ချက်

ဤစာတမ်းတွင် သတင်းခေါင်းစီး၏ သဘောသဘာဝကို ဦးစွာရှင်းလင်းတင်ပြခဲ့ပါသည်။ ထို့နောက် သတင်းခေါင်းစီး (၅) မျိုး သတ်မှတ်ခြင်းနှင့် ထို (၅) မျိုး၏ သဘောသဘာဝကို သာဓက များနှင့်တကွ ဖွင့်ဆိုရှင်းပြခဲ့ပါသည်။ စာတမ်း၏ အဓိကတွေ့ရှိချက်ဖြစ်သော ကြေးမုံနှင့် မြန်မာ့ သတင်းစာ ခေါင်းစီးများကို (၅) မျိုး ခွဲခြား၍ ဖော်ထုတ်တင်ပြထားပါသည်။

အခြေအနေကို ဖော်ပြသည့် သတင်းရေးဟန်သည် ဘက်လိုက်မှု မရှိသော သာမန် အသိပေး ဖော်ပြလိုသည့် သတင်းခေါင်းစီးမျိုးဖြစ်ကြောင်း သုံးသပ်တင်ပြထားသည်။ သတင်း၏ ဖြစ်ရပ် တစ်ခုကို အနှစ်ချုပ်ဖော်ပြထားခြင်းဖြစ်ပြီး အချိန်တိုအတွင်း သိရှိစေနိုင်ပါသည်။

လမ်းညွှန်သတိပေးမှုကို ဖော်ပြသည့် သတင်းခေါင်းစီးရေးဟန်သည် နိုင်ငံတော်အစိုးရ၏ လမ်းညွှန်ချက်များကို ပြန်လည်သတင်းခေါင်းစီးတပ်၍ ရေးဖွဲ့ထားသဖြင့် သတင်းစာရေးသူက သတင်းစာ ဖတ်သူကို လွှမ်းမိုးနိုင်သည်။

ဆန္ဒကို အကြံပြု သတင်းခေါင်းစီးရေးဟန်သည် ပြည်သူလူထုနှင့် နီးစပ်သူများဖြစ်၍ လူထုအသံများ သတင်းစာတွင် ဖော်ပြလေ့ရှိသည်။ သတင်းစာဖတ်သူများ ဖြစ်လိုသောဆန္ဒ ပြည်သူ လူထုအသံကို သတင်းရေးသားသူက လူထုအသံကို သတင်းခေါင်းစီးအဖြစ်ရေးသားသည့် သတင်း ခေါင်းစီး ရေးဟန်မျိုးကို သတင်းခေါင်းစီးအဖြစ် အသုံးပြုရေးသားလေ့ရှိသည်။

သို့ဖြစ်၍ သတင်းခေါင်းစီးတွင် အသုံးပြုသော စကားလုံးမှာလည်း ပျော့ပြောင်းသော လေသံကြောင့် ပြည်သူတို့တွင် ဆန္ဒကိုဖော်ပြမှုလိုလားချက်ကို သတင်းရေးသူမှတစ်ဆင့် သက်ဆိုင်ရာ

¹⁵ မြန်မာ့အလင်း ၂၀၁၆ ခုနှစ်၊ ဧပြီလ ၃ရက်၊ ၅၊

¹⁶ မြန်မာ့အလင်း ၂၀၁၆ ခုနှစ်၊ ဧပြီလ ၃ရက်၊ ၃၊

နိုင်ငံတော်အကြီးအကဲများ သိရှိစေနိုင်သည်။ တစ်နည်းအားဖြင့် ပြည်သူလူထု၏ ဆန္ဒကို စာရေးသူက အကြံပြုရေးသားသည့် ရေးဟန်ဟု ဆိုရမည်ဖြစ်သည်။

နိုင်ငံတော်ပိုင် သတင်းစာများတွင် ရေးသားသော သတင်းစာများတွင် ဖော်ပြသည့် သတင်းခေါင်းစီးများတွင် ပြည်သူလူထု အသက်အိုအိမ်စည်းစိမ်ကို ကြိုတင်ကာကွယ် ထိန်းသိမ်း ပြင်ဆင် နိုင်ဖို့အတွက် မိုးလေဝသသတင်းများ၊ နိုင်ငံတကာ ပြည်တွင်းပြည်ပနှင့်ပတ်သက်၍ ကုန်စည်စီးဆင်းမှု သတင်းများ ကောက်ပဲသီးနှံအထွက်တိုးသတင်းများ၊ ကူးဆက်ရောဂါ အမျိုးမျိုး ဆိုင်ရာသတင်းများ၊ ငွေကြေးစီးဆင်းမှုဆိုင်ရာသတင်းများ နိုင်ငံရေးအခြေအနေ သတင်းများ၊ အားကစားပြိုင်ပွဲဆိုင်ရာ သတင်းများ စသည့် သတင်းအမျိုးမျိုးတို့ကို သတင်းခေါင်းစီး အမျိုးအမျိုးဖြင့် ရေးသားသည့် သတင်းရေးဟန်မျိုးဖြစ်သည်။ ထိုခန့်မှန်း သတင်းသုံးသပ်မှုကြောင့် လူထုအနေဖြင့် ကြိုတင်ပြင်ဆင်မှု အမျိုးမျိုးကို ဆောင်ရွက်နိုင်သည်။

ထိုသို့သော သတင်းအကြောင်းအရာ အမျိုးမျိုးကို စိတ်ဝင်စားစေရန်အလို့ငှာ သတင်းခေါင်းစီးကို ဆွဲဆောင်မှု ရှိစေရန်အတွက် လူအများ စိတ်ဝင်စားစေသည့် သတင်းခေါင်းစီး ရေးဟန်မျိုးကို ရေးသား ကြခြင်းဖြစ်သည်။

သတင်းတစ်ပုဒ်တွင် စာဖတ်သူနှင့် ပထမဆုံး ထိတွေ့ရသည့် အပိုင်းများ သတင်းခေါင်းစီး တပ်ခြင်းဖြစ်သည်။ သတင်းခေါင်းစီးသည် သတင်းတစ်ပုဒ်အတွက် အတိုဆုံး အနှစ်ချုပ်တစ်ခု ဖြစ်သည်။ သက်ဆိုင်သော သတင်းစာ၏ ရပ်တည်ချက် မူဝါဒသဘောတရားကို ဖော်ပြနိုင်သည်။ သတင်းခေါင်းစီး ရေးသားရာတွင် နိုင်ငံတော်ပိုင် သတင်းစာများဖြစ်၍ သတင်းခေါင်းစီးများ ရေးသော သတင်းခေါင်းစီး ရေးဟန်မှာ တည်ငြိမ်သော သတင်းရေးဟန်မျိုးကိုသာ အသုံးပြု ကြောင်း တွေ့ရပါသည်။

သတင်းခေါင်းစီး တပ်ခြင်းရည်ရွယ်ချက်မှာ စာဖတ်သူ၏ အာရုံကိုဆွဲဆောင်မှုရှိရန်၊ သတင်းအကျဉ်းချုပ်ကိုပြောပြရန်၊ သတင်းများကို အဆင့်ခွဲနိုင်ရန်၊ သတင်းအကြောင်းအရာ၏ ရသအရည်အသွေးပြသရန် ရည်ရွယ်၍ သတင်းခေါင်းစီးများကို စာလုံးအရွယ်အစား (ပွိုင့်/လိုင်း) အမျိုးမျိုး ကစား၍ သတင်းခေါင်းစီးတပ်ကြသည်။ သတင်းခေါင်းစီးတပ်ရာတွင် သတင်း အထပ်အဆင့်ဖြင့် အလှတန်ဆာဆင်ခြင်း သတင်းခေါင်းစီးအစု၊ ခေါင်းစီး၏ အပေါ်ပိုင်းအထပ်၊ ထိပ်ခေါင်း ဟူ၍ ခေါ်သည်။ တစ်နည်းအားဖြင့် သတင်းစာပါ စာမျက်နှာခုနစ်ကော်လံပါ အပြည့်တပ်သောကြောင့် သတင်းခေါင်းစီး နဖူးစီးစာတမ်းဟုခေါ်သည်။ သတင်းခေါင်းစီးကို ကော်လံသုံးကော်လံ၊ လေးကော်လံခေါင်းစီးကို စာလုံးအရွယ်အစား ကြီးကြီးမားမားနှင့် တပ်သော ခေါင်းစီးမျိုးကို နာဖူးစီးခေါင်းဟုခေါ်သည်။

သတင်းခေါင်းစီးရေးဟန်များကြောင့် ပြည်သူလူထုနှင့် အစိုးရတို့၏ အခြေအနေ၊ လမ်းညွှန်မှု၊ သတိပေးခြင်း၊ ပြည်သူ့ဆန္ဒကို အကြံပြုဖော်ပြခြင်း၊ အခြေအနေအရပ်ရပ်ကို သုံးသပ် ဖော်ပြခြင်းတို့ကို လူအများစိတ်ဝင်စားဖွယ်ဖြစ်အောင် ပေါင်းကူးပေးထားခြင်းဖြစ်၍ သတင်းစာပါ သတင်းခေါင်းစီး၏ အရေးပါမှုကို လေ့လာတွေ့ရှိရသဖြင့် သတင်းခေါင်းစီးရေးဟန် သည် သတင်းစာ မျက်နှာတွင် ခိုင်မာစွာရပ်တည်ပေးသည့် သတင်းရေးဟန်ဖြစ်ကြောင်း တွေ့ရှိရပါသည်။

နိဂုံး

ဥပဒေပြုရေးမဏ္ဍိုင်၊ တရားစီရင်ရေးမဏ္ဍိုင်၊ အုပ်ချုပ်ရေးမဏ္ဍိုင်၊ စာနယ်ဇင်းမဏ္ဍိုင် ဟူသော မဏ္ဍိုင်လေးရပ်အနက် စတုတ္ထမဏ္ဍိုင်သည်ဖြစ်သည်။ စာနယ်ဇင်းမဏ္ဍိုင်သည် နိုင်ငံတော် တည်ဆောက်ရေးအတွက် အရေးပါသကဲ့သို့ မြန်မာဘာသာစကားသည် စာပေတိုးတက်ရေး အတွက် အရေးပါသည်။ စာရေးသူက စာဖတ်သူ ပြည်သူကို သတင်းပေးရာတွင် သတင်းမှန် ဖြစ်ရန် ကြိုးစားအားထုတ်ခြင်း၊ အဖွဲ့အစည်း ပုဂ္ဂိုလ်ထိလိုက်စေမည့် အရေးအသားများကို ရှောင်ကြဉ်ရေးသားရမည်။ သတင်းရေးဟန်၏ အစိတ်အပိုင်းဖြစ်သည့် သတင်းခေါင်းစီးရေးဟန် ကို ဤသတင်းစာတွင် ကြေးမုံနှင့် မြန်မာ့အလင်း သတင်းစာများမှ သတင်းခေါင်းစီးရေးဟန်များ ကို ရေးဟန်ပညာ ရှုထောင့်မှ လေ့လာဖော်ထုတ်တင်ပြခဲ့ ပါသည်။ ဤလေ့လာတွေ့ရှိချက်များ အရ သတင်းရေးနည်းများ၏ ရေးဟန်သည် မည်မျှအရေးပါကြောင်း စိစစ်တွေ့ရှိနိုင်ပါသည်။ သတင်းခေါင်းစဉ်ရေးဟန် ဖော်ပြမှုကြောင့် သတင်းစာ၏ အရည်အသွေးမှာလည်း ပိုမို တောက်ပြောင်လာပါသည်။ ဆက်လက်၍လည်း သတင်းခေါင်းစီးရေးဟန်များကို အခြားပညာ ရပ် နယ်ပယ်အသီးသီးမှ ဖော်ထုတ်လေ့လာ သုတေသနပြု ဖော်ထုတ်ကြည့်ပါက ဘာသာရပ် နယ်ပယ်အချင်းချင်း ဆက်စပ်မှုသဘောလည်း ပေါ်လွင်မည်။ သတင်းခေါင်းစီးများ၏ အရေးပါမှု အခန်းကဏ္ဍမှာလည်း ပိုမိုပေါ်လွင် ထင်ရှားလာမည်ဖြစ်ပါသည်။

ကျမ်းကိုးစာရင်း

ခင်မင်၊ မောင် (ခနုဖြူ)။ (၁၉၈၅)။ စကားပြေသဘောတရား စကားပြေအတတ်ပညာ။ ရန်ကုန်၊ မြန်မာစာဌာန၊ ရန်ကုန်တက္ကသိုလ်

ခင်မင်၊ မောင် (ခနုဖြူ)။ (၁၉၈၅)။ ရေးဟန်ပညာ နိဒါန်း။ ရန်ကုန်၊ စိတ်ကူးချိုချိုစာပေ။

ခင်နှင်းရည် (ရန်ကုန်တက္ကသိုလ်)။ (၂၀၁၆)။ သတင်းအတတ်ပညာနှင့် မြန်မာစာ အသုံးအနှုန်း ဆက်နွယ်မှု။ ရန်ကုန်၊ စာပေဗိမာန်။

ချိုချိုမြင့်၊ ဒေါက်တာ။ (၂၀၀၇)။ ရေးဟန်မိတ်ဆက်၊ ရန်ကုန်တက္ကသိုလ်မဂ္ဂဇင်း။ ရန်ကုန်၊ ရန်ကုန်တက္ကသိုလ်။

ချစ်စံဝင်း။ (၂၀၀၇)။ သတင်းစာပညာ။ ရန်ကုန်၊ ပန်းမျိုးတစ်ရာစာပေ။

စာပေဗိမာန်။ (၁၉၇၈)။ သတင်းစာပညာ။ ရန်ကုန်၊ စာပေဗိမာန်။

စိုးစိုးနိုင် (ကြေးမုံ)။ (၂၀၀၉)။ မှော်ဝင်သတင်းသမားများ နည်းနာခံယူရမည့် သတင်းစာပညာ။ ရန်ကုန်။

စိုးနိုင် (ဒေါက်တာ)။ (၂၀၁၉)။ ဆရာဇော်ဂျီ၏ ရသစာပေနိဒါန်း။ ရန်ကုန်၊ ထွန်းဖောင်ဒေးရှင်း စာပေကော်မတီ။

စိန်ဝင်း၊ ဦး (ဂါးဒီးယန်း)။ (၁၉၉၃)။ စတုတ္ထမဏ္ဍိုင်နှင့် ဂါးဒီးယန်းသတင်းစာ။ ရန်ကုန်၊ ပြန်ကြားရေးဝန်ကြီးဌာန။

စိန်ဝင်း၊ ဦး (ဂါးဒီးယန်း)။ (၂၀၀၀)။ အခြေပြသတင်းစာပညာ။

စိန်ဝင်း (လူထု-)။ (၂၀၀၃)။ သတင်းစာပညာသောင်းပြောင်းထွေလာ။ ရန်ကုန်၊ စာအုပ်ဈေး။

ဆုရှင်၊ မောင်၊ သိန်းတန် (ဟံသာဝတီ) နှင့် ပေါ်ထွန်း၊ မောင်။ (၁၉၇၄)။ စာနယ်ဇင်းဟူသည်။ ရန်ကုန်၊ စာပေလောက။

မြတ်သူ (ရန်ကုန်တက္ကသိုလ်-)။ (၁၉၇၄)။ ဘက်စုံသတင်းစာပညာ။ ရန်ကုန်၊ ဓူဝံစာပေ။

မြန်မာစာအဖွဲ့။ (၁၉၉၁)။ မြန်မာအဘိဓာန်။ ရန်ကုန်၊ မြန်မာစာအဖွဲ့ဦးစီးဌာန။

မြန်မာနိုင်ငံသတင်းစာဆရာအသင်း။ (၁၉၆၃)။ သတင်းစာပညာ။ ရန်ကုန်၊ ကြေးမုံ။

လှ၊ ဦး (လူထု-)။ (၁၉၆၃)။ သတင်းစာများသည် သမိုင်းကိုပြောနေကြသည်။ မန္တလေး၊ လူထုကြီးပွားရေးစာအုပ်တိုက်။

ဝံသာ၊ မောင်။ (၂၀၀၅)။ သတင်းစာပညာသဘောတရားနှင့် လက်တွေ့။ ရန်ကုန်၊ ဒေါင်းစာပေ။

ဝံသာ၊ မောင်။ (၂၀၀၈)။ သတင်းဋီကာ။ ရန်ကုန်၊ နန်းဒေဝီသာပေ။

သစ်လွင်၊ မောင် (လူထု)။ (၂၀၀၈)။ ရှေးဦးမြန်မာသတင်းစာများ (ဒုတိယအကြိမ်)။ ရန်ကုန်၊ နေရီစာအုပ်တိုက်။

AN ANALYSIS ON THE ERRORS OF SECOND YEAR ENGLISH SPECIALIZATION STUDENTS IN THE USE OF ADJECTIVES

Yee Yee Aung*

Abstract

Positions of adjectives in English play an important role for learners of English as a foreign language because it is not easy for EFL learners to put adjectives in the right position in English. Most of the students use adjectives in the wrong place, especially in constructing sentences and writing compositions. The possible reason is that students are weak in using adjectives correctly. This paper focuses on the positions of adjectives in English. The aim of this paper is to view what kinds of errors students made, why they committed such errors, and to find ways to overcome them. This study employed Mohamed and Li Lian's classification criteria on writing errors to explain the occurrence of errors in terms of overgeneralization, ignorance of rule restrictions, incomplete application of rules, and false concept hypothesized. Participants in this study were one hundred students from Second Year English Specialization class. The result of the research shows that 38% of the students made mistakes in arranging descriptive adjectives. The second most error is the use of **no** as a determiner and the use of **no** in spoken form. It is found that 26 out of 100 students can give correct answers to all 10 items. Three kinds of errors were discovered in this study. This paper enlightens the researcher students' grammatical incompetence and ways to overcome them. It is expected that this paper helps the language teachers and language learners to notice such errors and improve their grammatical competence in English, especially in writing. This paper thus recommends doing more study on other errors in order to improve their language ability in the teaching learning process of EFL teachers and learners.

Key words: adjectives, adjectives errors, English sentences, EFL learners

Introduction

In Myanmar, English is taught as a foreign language and EFL learners have to study eight parts of speech in English Grammar. Adjective includes one of them. Myanmar students have studied eight parts of speech in English since their Grade six. Nevertheless, they often encounter difficulties in using adjectives in English sentences. The possible reason is that the positions of adjectives in English are different from positions of adjectives in Myanmar. In the exams, students make mistakes in the use of adjectives. As a language teacher, it is necessary to check whether his or her EFL learners are proficient enough in their foreign language. Then, they will be able to fulfill their students' needs and they themselves can realize their weaknesses in their language teaching process. That leads to the improvement of students' language ability. This study is to explain the probable causes of adjective errors and find ways to overcome them.

Aim and Objectives

The purpose of this paper is to analyze the errors of second year English specialization students in the use of adjectives in English. To accomplish this study, students were asked to participate in an on-line activity. A set of multiple choice questions was sent to them.

Specific objectives to do this paper are:

- to recognize students' errors in adjectives
- to find ways to overcome students' errors in adjectives
- to raise students' grammatical competence
- to improve students' writing skills and language ability.

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Literature Review

According to A.J. Thomson and A.V. Martinet (1960), adjective in English can be defined as a descriptive word that describes nouns or pronouns. According to Sayagyi Maung Khin Min, eight parts of speech in Myanmar Grammar were just the adoption from English language. Nevertheless, each and every language has its own characteristics.

For example; Subject + Verb + Object (English) He tore the book.

Subject + Object + Verb (Myanmar) He the book tore.

Adj phrase/adj clause + N (Myanmar) N + Adj phrase/adj clause (English)

Before or after N (Myanmar) Adj + N (English)

In 2010, Abdul Rashid Mohamed and Goh Li Lian from Wan Rose Eliza University, Malaysia did a research on English errors and Chinese learners. Their paper examines the errors committed by second language learners in English essay writing based on eight selected grammatical items and makes recommendations to improve English writing skills in Malaysia. In 2016, a Chinese teacher did a thesis entitled 'An Analysis of the Common Errors in Chinese Students' English Writing.'

Research Methodology

All researchers agree that errors are deviations from a selected norm of the target language. Error analysis is the study and analysis of errors committed by second or foreign language learners. The purpose of this paper is to analyze the errors of the second year English specialization students in the use of adjectives in English. To accomplish it, the students were asked to participate in an on-line activity. A set of multiple choice questions was sent to them. Ten items were included in the question. Each item contained some possible mistakes usually made by students. Participants were a hundred students from the second year English specialization class studying in East Yangon University. They have been studying English since their primary school. They have studied English Grammar since their Grade-six. This study employed the theory of Error Analysis and followed Mohamed and Li Lian's classification criteria on writing errors. Errors on adjectives committed by the participants were collected, identified and classified into four groups: over-generalization, ignorance of rule restrictions, incomplete application of rules and false concept hypothesized. Only comprehensible and incomprehensible errors were analyzed as they were indicative of the students' grammatical incompetence. This research will answer the following questions:

- (1) What kinds of errors did students make?
- (2) Why did they do such mistakes?
- (3) How will such problems be solved?

Findings and discussion

During the process of language teaching and learning, no one can skip errors. Errors are significant in telling the students' proficiency level. Errors can be classified into many types according to different criteria. This study followed Mohamed and Li Lian's classification criteria on writing errors. It includes possible errors in adjectives and the reasons that cause such errors. Correct answers for each question are in bold types.

Q.1. Buy me **(a) a round wooden table** (b) a wooden table round (c) a wooden round table.

Table 1

Option	Correct/Incorrect	No. of Ss	Kind of error
a	Correct	62	Over-generalization
b	Incorrect	-	
c	Incorrect	38	

According to Table (1), 62 students got the correct answer for Question No.1. It is assumed that they know adjectives order very well. No one chose answer b and it shows that they all know adjectives come before nouns. 38 out of 100 students got the wrong answer. A possible explanation for the occurrence of the error is ‘over-generalization.’ To Myanmar learners, English language is basically complicated and confusing most of the time. As there are many grammar rules to remember, they often reduce their linguistic burden by storing either the base form or the frequently used structure. 38% of students may not know opinion adjectives and fact or descriptive adjectives. Some of them have frequently seen the word ‘round table’ in ‘round table discussion.’ Moreover, in Myanmar language, the word ‘wooden’ comes first. They, therefore, over-generalized it as in answer c.

Q.2. Are you feeling (a) heat **(b) hot**?

Table 2

Option	Correct/Incorrect	No. of Ss	Kind of error
a	Incorrect	3	Ignorance of rule restrictions
b	Correct	97	

According to Table (2), 97% of the students can choose the right answer. They were assumed to have digested the grammatical pattern of the verb **feel + adj.** Only 3% of the students chose the wrong answer. It seems that they do not know the formation of words (which is Noun or which is Adjective?) Another reason is that they do not use the correct pattern ‘feel + **the** + heat’. Such kind of error is called ‘ignorance of rule restrictions.’ 3 out of 100 students were either ignorant or unaware of the various conditions existing in English that require the use of articles. In Question 2, article ‘the’ is needed if the verb ‘feel’ is used with ‘heat’ (Noun).

Q.3. I will show you (a) strange something **(b) something strange.**

Table 3

Option	Correct/Incorrect	No. of Ss	Kind of error
a	Incorrect	10	Over-generalization
b	Correct	90	

According to Table (3), 90% of the students can give the correct answer to Question 3. This sentence structure seems very familiar with them, especially in their spoken language in English. However, 10% of the students cannot give the correct answer. It is assumed that they take it in accordance with their Myanmar language. Such error is termed as **over-generalization.**

Q. 4. It is no (a) goodness **(b) good** to argue with her.

Table 4

Option	Correct/Incorrect	No. of Ss	Kind of error
a	Incorrect	28	Ignorance of rule restrictions
b	Correct	72	

According to Table (4), 72% of the students get the correct answer for Q.4. They seem to know the expression ‘no good.’ 28% of the students may not know it. Possible error of this class is ‘ignorance of rule restrictions’. Their prior knowledge seems to remind them that the word ‘no’ is followed by ‘noun’. They don’t know that the word ‘no’ can be followed by noun, adjective, adverb and –ing form.

Q.5. Give me (a) the biggest (b) the big **(c) the bigger** one if you have only two left.

Table 5

Option	Correct/Incorrect	No. of Ss	Kind of error
a	Incorrect	10	Incomplete application of rules
b	Incorrect	10	Over-generalization
c	Correct	80	

According to Table (5), 80 out of 100 students chose the correct answer for Q. 5. They understand the degrees of adjectives very well and are able to use them correctly. 10 % of the students chose the wrong answer (a. the biggest) even though they were given the hint 'if you have only two left'. Such error is termed as 'incomplete application of rules'. Although there is an arrangement (The + adjective), the reader could not make out what the respondent was trying to say. In other words, the error obstructs the understanding and interpretation of the text (incomprehensible error). Another 10% of the students chose the wrong answer (b. the big). It seems that they take it in Myanmar. Such error is termed as 'over-generalization'.

Q.6. The jury found him **(a) guilty** (b) guilt.

Table 6

Option	Correct/Incorrect	No. of Ss	Kind of error
a	Correct	96	
b	Incorrect	4	Ignorance of rule restrictions

According to Table (6), 96% of the students can give the correct answer to Question. 6. Only 4 students cannot give the correct answer. It is assumed that they do not know the sentence structure- find+object+adjective. Or, they do not know the word formation like guilt (N) and guilty (adj). It is also assumed that they think that sentence in Myanmar language. Such error is considered as 'ignorance of rule restrictions.'

Q. 7. John is always (a) neat (b) tidy **(c) neat and tidy**.

Table 7

Option	Correct/Incorrect	No. of Ss	Kind of error
a	Incorrect	4	Ignorance of rule restrictions
b	Incorrect	5	Ignorance of rule restrictions
c	Correct	91	

According to Table (7), 91 students give the correct answer to Q. 7. They seem to be familiar with the expression, 'neat and tidy' which is called 'fixed collocation'. 9 students were either ignorant or unaware of this collocation. Such error is called 'ignorance of rule restrictions.'

Q. 8. (a) Near you the salt me pass. (b) Pass me near you the salt. **(c) Pass me the salt Near you.**

Table 8

Option	Correct/Incorrect	No. of Ss	Kind of error
a	Incorrect	1	Incomplete application of rules
b	Incorrect	-	
c	Correct	99	

According to Table (8), 99 students can give the correct answer to Q.No. 8. It is assumed that they know basic sentence pattern in English very well. They understand phrases and clauses

in English. There is only one student who gives the wrong answer. It is thought that he or she does not know English phrases and clauses. He or she chooses the wrong answer ((a) Near you the salt me pass. He or she seems to translate it in Myanmar. This type of error is ‘incomplete application of rules.’ It has so many errors in grammar and the readers cannot see what the intended meaning is. Such error is classified as an incomprehensible error.

Q. 9. The principal tells the students to keep their campus (a) cleanliness **(b) clean** (c) cleanly.

Table 9

Option	Correct/Incorrect	No. of Ss	Kind of error
a	Incorrect	2	Ignorance of rule restrictions
b	Correct	72	
c	Incorrect	26	Over-generalization

According to Table (9), 72% of the students can give the correct answer to Q.9. It is assumed that they know the sentence structure- keep+object+adjective. 26 students chose the wrong answer (c. cleanly) because they have studied that adverb is used to modify a verb. Such error is called ‘over-generalization’. Only 2 students chose another wrong answer (a. cleanliness). They do not know the correct structure- keep+object+adjective. Such error is termed as ‘ignorance of rule restrictions.’

Q. 10. The film that we watched last night is really (a) fright **(b) scary**.

Table 10

Option	Correct/Incorrect	No. of Ss	Kind of error
a	Incorrect	4	Ignorance of rule restrictions
b	Correct	96	

According to Table (10), 96% of the students give the correct answer to Q. 10. They seem to know the sentence structure ‘verb to be + adv+ adj’ very well. They have studied that ‘fright’ as Noun and ‘scary’ as Adjective. Four students do not seem to know that sentence structure and the correct word forms. Such error is under the heading ‘ignorance of rule restrictions.’

Table 11

Questions	1	2	3	4	5	6	7	8	9	10
No of Ss	38	3	10	28	10+10	4	9	1	2+26	4
Kinds of error	O	Ig	O	Ig	Inc+O	Ig	Ig	Inc	Ig+O	Ig

Over-generalization (O)

Incomplete application of rules (Inc)

Ignorance of rule restrictions (Ig)

Table (11) shows that the majority of the students committed most of the errors in Question 1. 38% of the students are found out to be weak in ‘adjectives order’. The students made the second most errors in Question 4. It shows that 28% of the students were either ignorant or unaware of the various usages of ‘no.’ The third most common kind of error that the students committed is the usage of the verb ‘keep’ in Question 9. 26% of the students presumed every verb is followed by adverb. It shows that they assume the target language ‘S +V + Adv’

form unchangingly instead of storing many grammar rules. 99 students chose the correct answer to Question 8. Only one student showed a tendency to produce deviant structure. The kinds of errors found in this study are ‘over-generalization’ (4 items), ignorance of rule restrictions’ (6 items), and ‘in complete application of rules’ (2 items). One kind of errors caused by false concept hypothesized is not found at all. Despite the fact that only one student committed an incomprehensible error, the analysis of data revealed most of the errors committed by the students were comprehensible ones. 26 out of 100 students can handle all the given items concerning adjectives, well.

Ways to overcome the errors

To overcome the errors of adjectives encountered in this study, the researcher as well as a language teacher will advise the students or the language learners

1. to study the basic rules of English grammar,

This is to tell the students that there are so many grammar rules in every language and they should study them thoroughly. If not, they won’t get a concrete answer.

e.g. (1) **keep+object+adjective** in Question (9)

e.g. (2) **fright** (noun), **scary** (adjective) in Question (10)

2. to collect more language points and contrast the harmony and difference of two languages,

This is to tell students that they should often contrast the vocabulary, commonly used words, and sentence patterns of the two languages so that they may know the harmony and difference of them like Question (8).

3. to memorize distinct features of some words,

There are some words and expressions which have their distinctions or graceful characters in their language. To master them, students must learn them by heart. In other words, they should study some special usages well like Question (3) and (7).

4. not to generalize the factors in a language to another language.

Every language has its own usages and structures and they are not the same. For example, In Myanmar grammar, adjective phrases and adjective clauses come before the noun they modify whereas they appear after the noun they modify in English like **a round wooden table** in Q. (1).

Conclusion

This study explores the errors of the use of adjectives in English made by the second year English specialization students. Adjectives are noun modifiers in both English language and Myanmar language. In Myanmar grammar, adjective phrases and adjective clauses come before the noun they modify whereas they appear after the noun they modify in English. After identifying and analyzing all the data, this study concludes two points. Out of ten items, ‘**adjectives order**’ is the first errors, the word ‘**no**’ is the second most errors and the verb ‘**keep**’ is the third most errors made by the second year English specialization students.

According to Mohamed and Li Lian’s classification criteria on writing errors, adjective errors are classified into four groups. In this study, ignorance of rule restrictions is found six times. Over-generalization is seen four times, and incomplete application of rules is gathered twice. Fortunately, the error concerning false concept hypothesized is not seen at all in this study. Such kind of error is a result of faulty comprehension of distinctions in the target language. In short, the Second Year English Specialization students of East Yangon University do not commit the worst errors in using adjectives.

Recommendations

This paper thus recommends the incorporation of explicit grammar instructions in the teaching of English as a foreign language in order to improve grammatical competence in English. Teachers should investigate and identify grammatical items which pose difficulty to

students so that they can notice their students' errors and raise their students' grammatical competence. Then, students can improve their writing skills and language ability. No one can deny that it is very important for language learners to gain competence in a wide range of skills so that they can perform well. Hence language teachers and EFL learners are more and more encouraged to conduct a survey on other errors so as to improve their teaching learning process.

To sum up, this study shows that each and every language has its own structure and usage. It helps the researcher see the students' needs in adjectives and this leads to the teaching learning activities that cater the students' needs. It is hoped that this study can give some benefits not only to the foreign language learners but also to the language teachers.

Acknowledgements

I would like to express my heartiest thanks to our Rector Dr. Nay Win Oo for his kind permission to do this paper. I also thank Dr. Aye Aye Ko, Dr. Thida Aung and Dr. Wah Wah Lwin, our Pro-rectors of East Yangon University for their kind permission to do this paper. My thanks also go to Dr. Aung Kyi, Professor and head of the English Department and Daw Aye Aye Maw, Associate Professor of the English Department of East Yangon University for their valuable suggestions to accomplish this paper. Moreover, I also thank Daw Kyi Kyi Wai and Daw Moe Moe San, teachers from Department of Myanmar, Hinthada University, who help me with the necessary information for this paper. Furthermore, my thanks also go to all my Second Year English Specialization students from East Yangon University who participate in my on-line activity for this paper. It is a great pleasure for me to express my gratitude to all the teachers in English Department for their suggestions.

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A STUDY OF THE POETIC COMPARISON AND THE STRUCTURE OF WORDSWORTH'S POEMS

Aye Aye Mar^{*}

Abstract

In the study of English poetry, the poems of William Wordsworth (1770-1850) cannot be passed unnoticed. They contributed to English poetry in two aspects.: firstly, common subject matters were used in poetry; secondly, the elegant language used for adornment of poetry was replaced by the language used by the common people. In line with the second principle of Wordsworth, this study focuses on William Wordsworth's language in his poems. In English literature, William Wordsworth was one of the famous romantic poets. His style of writing has a great influence on English poetry. The use of Wordsworth's language in his poems has often been noted for simplicity. It also includes a detailed analysis on the use of language with reference to some poems written by William Wordsworth. As a result, Wordsworth's success in poetry, his use of language, his choice of words as well as his vivid presentation which is closer to nature can be well-identified.

Key words: poems, language, contributed, nature, literature, influence, simplicity

Introduction

Throughout my life as a teacher as well as a student, poems of different types on various topics have been taught and learnt, ranging from nature poems to deep philosophical poems. Poems at various stages of life to some extent draw our attention and interests. These poems also have the ability to change our views, attitude, our values and philosophy of life. Moreover, in poems, patterns of different sounds in that language are carefully exploited to give the sound image or the smooth flow of the language. This gives the learners the sense of pleasure and joy while reciting them. Poems teach us how to use a language efficiently and enable us to be aware of our own language ability in our mother tongue and in the target language.

Some of those poems that caught our attentions and awareness of our natural surroundings are the poems written by William Wordsworth. He enables us to see things in nature closely and teaches us to enjoy the joyful accompany of nature when we are lonely. The topic usually chosen by Wordsworth is about nature. He portrays the beauty in nature by employing simple but effective use of language.

Among his many poems, the poems "I Wandered Lonely as a Cloud", "The World Is Too Much with Us" and "It Is a Beauteous Evening, Calm and Free" were selected for this research as they are remarkable. A comparison with the structures of the three poems is extremely interesting. The comparison of his poems gave us profound knowledge on William Wordsworth's writing style, the structure of the poems and literary devices which are valuable information for further study of Wordsworth's

poems. The 18th Century was known as the Age of the Romantic Revival. Before the Revival, English Literature had been under the influence of classicism and neoclassicism. According to these classicism and neoclassicism, English Poetry had been under the restraint of emotion and the rigid control form of poetry. An outstanding example is the poems of Alexander Pope. But in the early 18th Century, there was a change in the form of poetry as well as in the subject matter of poetry. That was the starting point of Romanticism. Wordsworth's poetry is noteworthy because it represents Romanticism. With the collaboration of Samuel Taylor Coleridge, Wordsworth was the pioneer of the Romanticism Revival in the early 18th Century.

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Aim and Objectives

The aim of this paper is to explore the characteristics of Romanticism in the three selected poems composed by William Wordsworth. The objectives of the paper are as follows:

1. to analyze the structures of his poems
2. to compare to the findings of the poems in terms of the literary devices

Literature Review

One of the definitions of poetry, mentioned by Wordsworth, is that all good poetry is the spontaneous overflow of powerful feelings. Poem is emotion recollected in tranquillity. The poet is a man who has the greater knowledge of human nature and the more comprehensive soul than other people. It is the life of nature which is everywhere recognized; not mere growth and cell changes. But sentient, personal life and the recognition of this personality in nature characterize the entire world's great poetry. In his childhood, Wordsworth regarded natural objects, the streams, the hills, the flowers, even the wind, as his companions and with his mature belief that all nature is the reflection of the living God. It was inevitable that his poetry should thrill us with the sense of a spirit that "rolls through all things". Cowper, Burns, Keats, Tennyson, all these poets give the outward aspects of nature in varying degrees. But Wordsworth gives his life, and the impression of some personal living spirit that meets and accompanies the man who goes alone through the wood and the fields. The delightful characteristics of Wordsworth's poetry seem to awaken love for natural beauty rather than create an impression.

According to the principle of Romanticism, the poets freed themselves from their bonds of poetic format and language. In the earlier centuries, the poets had to follow the poetic format and use the poetic language in writing poetry. But Wordsworth made a breakthrough in writing the poems of Romanticism.

Another aspect of Romanticism is that romantic poets made a swing from the head to the heart. That is to say, "In the earlier century, the poets had to follow the poetic formal and use the poetic structure revealing their emotions and their individuality in their poems". So, different poets wrote the same subject matters by using indifferent styles and themes.

Research Methodology

In comparing the three poems by Wordsworth, the analysis is made to find out the similarities and differences of the three poems. To do so, the poems are compared by analyzing the themes, rhyming schemes and figures of speech. Then, the findings are presented in terms of similarities and differences.

Figures of speech and rhyming schemes and choice of words are identified and presented. Concerning figures of speech, similes, personification, metaphor, hyperbole and repetition are identified and described. Rhyming words and rhyming schemes used in the poems are also investigated. The themes of the poems are identified and described in the findings and discussion section.

A Brief Study of Three Poems by Wordsworth

"I Wandered Lonely as a Cloud" takes place in the Lake District of Northern England. The area is famous for its hundreds of lakes, gorgeous expanses of springtime daffodils, and for being home to the "Lakeland Poets": William Wordsworth, Samuel Coleridge, and Robert Southey. The poem, obviously inspired by Wordsworth's stomping grounds, is well-loved because of its simple yet beautiful rhythms and rhymes, and its rather sentimental topic. The poem consists of four sestet stanzas, each of which follows an ababcc rhyme scheme. Each is written in iambic tetrameter, giving the poem a subtle back-and-forth motion that recalls the swaying daffodils.

The poet is enjoying his idle wandering. He is moving like a cloud which sails freely in the air over the hills and valleys. He sees a group of golden daffodil flowers beside a lake and underneath some trees. As it is a breezy day, the daffodils are fluttering and dancing on their

stems in the breeze. The daffodils which grow in scattered groups in the wild stretch continuously, without a break, like the stars in the milkyway. Thousands and thousands of daffodils stretch along the margin of a bay. And all these flowers are merrily dancing and so do the waves of the lake. Despite his earlier loneliness, the poet now cannot help but feel happy with such a beautiful vision to look at. At that time, his loneliness is replaced by joy. The daffodils and waves feel like companions to him. He keeps looking at the flowers as long as he can. He does not realize exactly how great of a gift he has just received from this vision. When the memory of the flowers and the lake flashes into his head, he feels happy again.

William Wordsworth's poem "It Is a Beauteous Evening, Calm and Free" is an Italian (Petrarchan) sonnet. Its rhyme scheme is ABBAACCA in the octave and DEFDFE in the sestet. The poem exemplifies the classic Romantic theme of infusing earthly loveliness and innocence with the Divine. Wordsworth asserted that poetry is produced from the "spontaneous overflow of powerful feelings". And he added, "it takes its origin from emotion recollected in tranquility".

This sonnet remains a brilliant example of Wordsworth's as well as Romanticism's statement of poetry. The poet narrates the poem as if he were talking to a child. They take a walk along the margin of the bay and the time is evening. The poet uses the word "beauteous" to signify that the beauty of the evening is not just for temporary but the permanent one. Everything on earth becomes permanent and concrete because they all are created by God. This thought is portrayed by the poet. The thought of the power of God is more evident in the presence of a young child because they have been specially created by God, the presence of God is more apparent in the children. The poet is praising the child for her innocence and purity which are the qualities adorned by God. The evening is beautiful, calm, and free. The time of devotion is as quiet as a nun who is wholeheartedly worshipping God. The sun is setting down quietly over the sea as God is gently watching. God shows his presence by making a sound like thunder. Even though the child who is walking with the poet appears untouched by the religious thoughts, her nature is not less divine. As she is securely in eternal salvation all the time, worshipping in great devotion, God is with her even when they are not aware of his presence.

In the poem "The World Is Too Much with Us", Wordsworth gives a fatalistic view of the world, past and future. The words "late and soon" in the opening verse describe how the past and future are included in his characterization of mankind. The author knows the potential of humanity's "powers", but fears are clouded by the mentality of "getting and spending". The "sordid boon" we have "given our hearts" is the materialistic progress of mankind.

He says that there are so many things that we should appreciate and cherish in life. We just get and spend little in the nature and that is ours, we have given our hearts away for nothing valuable. The poet means that we waste our lifespan just for unimportant things and forget to appreciate things of beauty in nature. It is just a disgusting disadvantage in life. The poet states that beautiful things include the Sea that bares her bosom to the moon, the broad sea that is always rising its tide to the moon's rays and, the winds that howl at all hours, these things will be useless like withered flowers, if we do not watch them. For this, for everything, we are out of tune; it has no effect on our lives. The poet wishes that he would rather be a Pagan, a wild primitive man, an atheist with no belief at all if he cannot appreciate the beauty of nature. If so, he might be standing on this pleasant lea, so that he may have glimpses that would make him less hopeless. He may have seen Proteus, the Greek God of Water, rising from the sea; or he may hear old Triton, another god of underwater world, blowing his twisted horn. So, according to the poet, we, the readers should appreciate things of beauty in nature and we should not spend our life by doing unimportant things.

The analysis of the poems “I Wandered Lonely as a Cloud”, “It Is a Beauteous Evening Calm and Free”, “the World Is Too Much with Us”

The three poems were investigated and compared with the themes, the rhyming schemes and the literary devices as follows:

Table (1) Comparison of the themes of the poems

Sr. No	Poems	Theme	No. of lines
1	I Wandered Lonely as a Cloud	Nature's Beauty	24
2	It Is a Beauteous Evening, Calm and Free	Nature's Tranquility	14
3	The World Is Too Much with Us	Nature's Materialism	14

Table (2) Comparison of the type and form of the poems

Sr. No	Poems	Type of poems	Form of poems
1	I Wandered Lonely as a Cloud	Lyric	Sestet
2	It Is a Beauteous Evening, Calm and Free	Petrarchan Sonnet	Octave & Sestet
3	The World Is Too Much with Us	Petrarchan Sonnet	Octave & Sestet

Table (3) Comparison of the rhyming schemes of the poems

Sr. No	Poems	Rhyming schemes
1	I Wandered Lonely as a Cloud	ABABCC
2	It Is a Beauteous Evening, Calm and Free	ABBAACCA, DEFDFE
3	The World Is Too Much with Us	ABBA, ABBA, CDCDCD

Table (4) Comparison of the literary devices (Similes) used in the poems

Sr. No	Poems	Similes
1	I Wandered Lonely as a Cloud	I wandered lonely as a cloud Continuous as the stars that shine
2	It Is a Beauteous Evening, Calm and Free	The holy time is quiet as a Nun A sound like thunder
3	The World Is Too Much with Us	Breathless with adoration And are up-gathered row like sleeping flowers

Table (5) Comparison of the literary devices (Hyperbole) used in the poems

Sr. No	Poems	Hyperbole
1	I Wandered Lonely as a Cloud	They stretched in never ending line Ten thousand saw I at a glance
2	It Is a Beauteous Evening, Calm and Free	-
3	The World Is Too Much with Us	-

Table (6) Comparison of the literary devices (Metaphor) used in the poems

Sr. No	Poems	Metaphor
1	I Wandered Lonely as a Cloud	They flash upon that in ward eye
2	It Is a Beauteous Evening, Calm and Free	A sound like thunder- everlastingly
3	The World Is Too Much with Us	A pagan suckled in a creed outworn

Table (7) Comparison of the literary devices (Personification) in the poems

Sr. No	Poems	Personification
1	I Wandered Lonely as a Cloud	(1) All at once I saw a crowd A host of golden daffodils (2) Fluttering and dancing in the breeze (3)Tossing their heads in sprightly dance (4)The waves besides them dance (5)The sparkling of heaven in glee
2	It Is a Beauteous Evening, Calm and Free	(1) The gentleness of heaven bounds o'er the sea
3	The World Is Too Much with U	(1)The sea that bears her bosom to the moon (2)The winds that will be howling at all Hours

Table (8) Comparison of the literary devices (Alliteration) used in the poems

Sr. No	Poems	Alliteration
1	I Wandered Lonely as a Cloud	I gazed and gazed but little thought And danced with the daffodils
2	It Is a Beauteous Evening, Calm and Free	God being with thee when we know the broad sun is sinking down it not
3	The World Is Too Much with Us	For this, for everything, we are out of tune Great God!

Table (9) Comparison of the literary devices (Tone) used in the poem

Sr. No	Poems	Tone
1	I Wandered Lonely as a Cloud	joyful & exciting
2	It Is a Beauteous Evening, Calm and Free	tranquil
3	The World Is Too Much with Us	elegiac

Table (10) Comparison of the use of nouns in the poems

Poems	I Wandered Lonely as a Cloud	It Is a Beauteous Evening, Calm and Free	The World Is Too Much with Us
Uses of Nouns	Cloud, vales, hills, crowd, host, daffodils, lake, trees, breeze, stars, way, line, bay, glance, head, dance, waves, glee, poet, company, thought, wealth, couch, mood, eyes, bliss, solitude, heart, pleasure	Evening, time, Nun, adoration, sun, tranquility, gentleness, heaven, sea, motion, sound, thunder, child, girl, thought, nature, divine, bosom, Temple, shrine	World, powers, nature, hearts, boon, sea, bosom, moon, winds, hours, flowers, tune, creed, glimpse, sight, horn

Table (11) Comparison of the use of verbs in the poems

Poems	I Wandered Lonely as a Cloud	It Is a Beauteous Evening, Calm and Free	The World Is Too Much with Us
Uses of Verbs	Wandered, float, saw, twinkle, stretched, danced, gazed, lie, fills, fluttering, dancing	Listen, make, walk, untouched, appear, know, sinking	Lay, see, given, bares, howling, gather, sleeping, moves, suckled, standing, having, rising, wreath

Table (12) Comparison of the use of adjectives in the poems

Poems	I Wandered Lonely as a Cloud	It Is a Beauteous Evening, Calm and Free	The World Is Too Much with Us
Uses of Adjectives	Lonely, golden, continuous, sprightly, sparkling, jocund, pensive, vacant, inward	Beauteous, calm, free, holy, quiet, Breathless, broad, mighty, eternal, dear, solemn, inner	Little, sordid, sleeping, great, pleasant, forlorn, outworn

Research Findings

The comparative study of Wordsworth's three poems showed similarities and differences of the themes and the use of literary devices. Though the same theme was used in those poems, the techniques and the choice of words were quite different. In the poem "I Wandered Lonely as a Cloud", the poet uses ABABCC (quatrain-couplet) rhyming schemes. But in the poem "It Is a Beauteous Evening, Calm and Free", ABBA ACCA DEFDFE (octave sestet), and in "The World Is Too Much with Us, ABBA, ABBA, CDCDCD rhyme schemes are used respectively. Concerning the literary devices, the use of similes, metaphor, personification, alliteration and tone uses found in all three poems. However, the use of hyperbole was found only in the poem "I Wandered Lonely as a Cloud". Moreover, a paradox was found in the poem "The World Is Too Much with Us" as in "We have given our hearts away, a sordid boon!".

In addition, the use of alliteration was found in the poem “I Wandered Lonely as a Cloud” as in “I gazed and gazed but little thought”, “And danced with the daffodils”. In “It Is a Beauteous Evening, Calm and Free”, the use of alliteration can be found in the lines “God being with thee when we know”, “the broad sun is sinking down it not”. In the poem “The World Is Too Much with Us”, “For this, for everything, we are out of tune” and “Great God!” can be found as the alliteration.

When the nouns used in the three poems were compared, nouns that indicated nature and things in nature such as “cloud, vales, hills, lake, trees, breeze, stars, bay, waves”, were identified in the poem “I Wandered Lonely as a Cloud”. Nouns like “evening, line, sun, tranquillity, sea, heaven, thunder, sound”, in “It Is a Beauteous Evening, Calm and Free” and nouns like “world, nature, sea, moon, winds, hours, flowers, tune, sight” were discovered (See Table-8). All these words reflect the idea of nature in the poems.

As William Wordsworth was known as the poet of nature, he wrote about the things in nature. He also wrote the poems about the common people. Unlike the poets of the preceding century, the subject of his poem was different in that his poems are portraits of man and nature. Unlike the poets of classical and neoclassical literature, Wordsworth introduced, not the poetic language and writing poetry, but the common language in poetry. He had revived Romanticism.

The speakers of Wordsworth’s poems are inveterate wanderers: they roam solitarily, they travel over the moors, they take private walks through the highlands of Scotland. Active wandering allows the characters to experience and participate in the vastness and beauty of the natural world. Moving from place to place allows the wanderer to make discoveries about himself. While wandering, speakers uncover the visionary powers of the mind and understand the influence of nature in “I Wandered Lonely as a Cloud”. The speaker of this poem takes comfort in a walk he once took after he has returned to the grit and desolation of city life. Recollecting his wanderings allows him to transcend his present circumstances.

In the poem “It Is a Beauteous Evening, Calm and Free”, Wordsworth praised the power of the human mind. Using one’s wisdom and problem solving skills, he could overcome difficulty and loss in his life. In Wordsworth’s poems, childhood is magical, magnificent time of innocence. Children form an intense bond with nature, so that they appear to be part of the natural world, rather than men of the world. Their relationship to nature is passionate and extreme: children feel joy at seeing a rainbow but great terror at seeing desolation or decay.

In the poem “The World is Too Much with Us”, Wordsworth takes an overall view of today’s society. He cannot see it in a positive light because most human beings are wasting their inborn qualities by running after the pleasures and personal wealth. They do not seize their power of imagination anymore. What is worse, they cannot see the beauties of nature that are all around us. Wordsworth suggested that if we had an eye for imagination, we could even see the mythological figures in the sunshine.

In conclusion, the three poems of Wordsworth proved that he was different from the earlier poets like Milton and Pope. He did not use the poetic language used by those poets, but first introduced the common language in poetry. These three poems of Wordsworth carry different subjects of poetry but have the same theme of nature.

Conclusion

Wordsworth’s poems are different from the poems of the earliest century in two aspects: the subject of poetry and the language of poetry. While the subject of his poetry is either man (the common people) or nature, the language of his poetry is simple and straightforward, being the language of the common people. Wordsworth was a daring poet for introducing a new subject and a new kind of language in poetry.

Such principles of Romanticism reflect that poetry is not an imitation of reality, and that poetry is the blending of reality and imagination. With the touch of fertile imagination, an ordinary

object of reality appears attractive to the eye of the observer and frees his imagination. Therefore, an ordinary sight or an ordinary sound means a lot in the realm of imagination. If it is colored with imagination, everything in the world will assume a new meaning to us. Thus, romanticism adds new meaning to our reality and to the world.

It was found that the poet always used these characteristics: the sensibility, love of nature, Individualism, unrestrained imagination and sentimental melancholy. Otherwise, he did not use the following characteristics: primitivism, romantic criticism, and reaction against neoclassicism, enthusiasm for the wild, irregular or grotesque nature, emotional psychology in literature, renewed interest in Spenser, Shakespeare and Milton. Instead, he often used the characteristics: sympathetic interest in the past, mysticism, enthusiasm for the uncivilized or natural, interest in ancient Celtic and Scandinavian mythology.

Acknowledgements

First of all, I would like to thank Dr. Nay Win Oo, Rector of East Yangon University and Pro-Rectors Dr. Aye Aye Ko, Dr. Wah Wah Lwin and Dr. Thidar Aung for giving me permission to do this research. I would also like to express my genuine gratitude to Associate Professor, Daw Aye Aye Maw, Head of the Department of English for her effective suggestion, comments, encouragement and submission of this paper. Moreover, my thanks also go to all my beloved teachers who taught me and imparted me knowledge about the English language throughout my schooldays and the university of life.

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SPATIAL ANALYSIS ON FOOD SHOPS IN THONEGWA TOWN

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Abstract

This paper studies “Spatial Analysis on Food Shops in Thonegwa”. The nature, number and types of food shops in Thonegwa are studied. Actually, food shops are different according to roads and streets. As a whole town, various types of food shops are studied by type, ward, road and street. The spatial distribution of food shops is analyzed by using Lorenz curve, mean center, standard distance and deviational ellipse methods and buffer zone. According to analysis, the spatial distribution of food shops depends on near market and good transportation. Majority of the food shops are concentrated in Ward No. 4. Most of the food shops are distributed along the Aung Zayya Road, Min Ye Kyaw Swar Road, Padonmar Road and Thipaw Street.

Key words: spatial analysis, food shops, Lorenz curve, mean center, deviational ellipse

Introduction

Thonegwa Township is situated in the Southern District of the Yangon Region. Thonegwa is located at the west of Thonegwa Township. The major road of Thonegwa is Aung Zayya Road. It connects with near-by towns; Khayan Township toward east and Thanlyin Township toward west. Thanlyin Township is linked with Yangon City by two bridges; Yangon-Thanlyin Bridge (1) and Yangon-Thanlyin Bridge (2). After the construction of Thanlyin's Bridge (1) & (2), the rapid growth of transportation and urbanization are important factors for the growth of population and commerce in Thonegwa. Thonegwa is easily accessible to other towns and village tracts. The consequence of population growth affects the spatial concentration of food shops in Thonegwa.

Research Problem

In Thonegwa Town, 264 food shops and twelve types are found. In 2019, the town's population was 28194 persons. Therefore, this research problem is “How food shops are distributed in terms of type in Thonegwa Town.

Aim

The main aim of this research is to analyse the spatial distribution of food shops in Thonegwa Town.

Objectives

The objectives of the research are as follow:

- to study the spatial distribution of food shops,
- to study the nature of types and numbers of food shops,
- to evaluate the influencing factors of food shops distribution and to examine the important of food shops in this study.

Study Area

The study area is Thonegwa which lies to the west of the Thonegwa Township. It is located at the junction of Hmaw Wun Chaung, Okkan Chaung and Takaw Chaung. The total

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area of Thonegwa has 7.38 square kilometer (2.5 square miles). It comprises 12 wards. In Thonegwa, there are various types of food shops.

Sources of Data and Methodology

In this study, relevant facts are derived from University of Central Library, East Yangon University, M.A Thesis and geographical text book. The statistical data and report from General Administrative Office, Agricultural Land Management and Statistics Department, Thonegwa Township are collected for ward area data, and maps. Field observations are done for interviews with sellers and customers and study for spatial distribution of food shops.

Lorenz curve, mean center, standard distance and deviational ellipse methods and buffer zone are used in the paper.

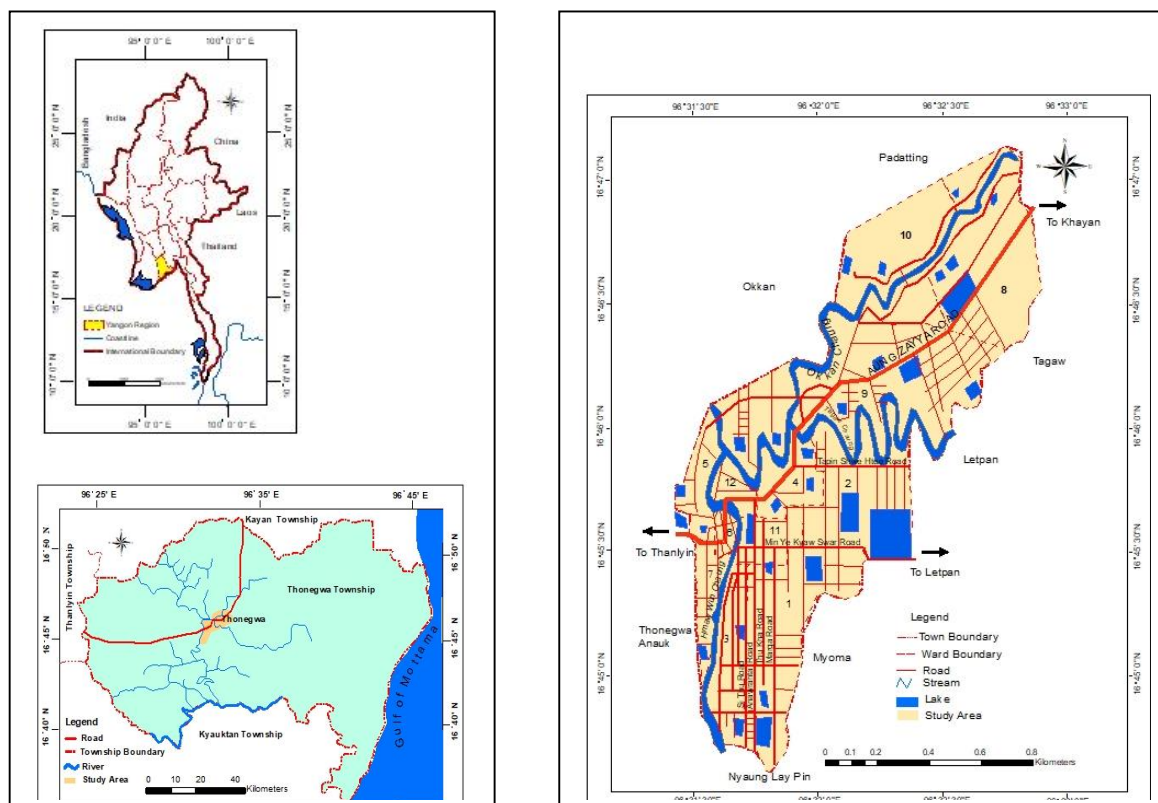


Figure 1. Location of the Study Area

Source: Agricultural Land Management and Statistic Department, Thonegwa Township

Results and Discussion

Background of the Study Area

Physical Background

Thonegwa is located at the west of Thonegwa Township. It is situated between $16^{\circ} 44' 50''$ and $16^{\circ} 47' 0''$ North Latitudes and between $96^{\circ} 30' 47''$ and $96^{\circ} 33' 10''$ East Longitudes. Thonegwa has 7.38 square kilometer. It comprises 12 wards.

Thonegwa Town has an elongated shape with a longer axis running southwest to northeast. Thonegwa Town is bounded on the east by Tagaw Village, Letpan Village and Myoma Village, on the south by Nyaung Lay Pin Village, on the west by Thonegwa Anauk Village and on the north by Padatting Village.

Thonegwa has a slightly rolling topology. Somewhat elevated surface is continuation of foothill of Bago Yoma, which trends from north to south within Yangon Region. The average elevation of Thonegwa is between 20 and 50 feet above sea level.

The main drainage of the town is Hmaw Wun Chaung, which flows from north to South, Tagaw and Okkan Chaung flow from east to west and enter into the Hmaw Wun Chaung.

Human Background

There are annual changes in population of Thonegwa. The total population of Thonegwa in 2010 was 27857. In 2019, the town's population increased to 28194. Because some peoples from villages within Thonegwa Township had migrated into this area.

Population distribution within Thonegwa is governed by economic development accessibility. The most population are concentrated in more accessible areas. The highest population of Thonegwa is Ward No.9. Because this ward is located near jetty, bus terminal. The lowest population of Thonegwa is Ward No. 11, because this ward is situated near government offices, schools, Pagoda and far from Aung Zayya Road. In 2019, The population density of Thonegwa is 3820.33 persons per sq-km. The highest density of population is found in Ward No. 3, Ward No. 7 and Ward No. 12. The lowest density of population is found in Ward No. 8 and Ward No. 10.

Spatial Distribution of Food Shops in Thonegwa Town

General Spatial Distribution of Food Shops

In Thonegwa, there are 12 wards. There are altogether 264 food shops in Thonegwa. Various types of food shops are found in all wards, along the nine roads and thirty-three streets.

The distribution pattern of food shops may be found in two patterns, multiple distribution pattern and single distribution pattern. Most of the shops open from 6:00 AM to 8:00 PM. In general, most of the food shops can be found in Aung Zayya Road, Min Ye Kyaw Swar Road, Padonmar Road and Thipaw Street.

Spatial Distribution of Food Shops by Types

In Thonegwa, there are twelve types of food shops (grocery shops, tea shops, betel & cheroot shops, restaurants, cold drink shops, Mohinga and salad shops, rice shops, rice & curry shops, fruit shops, liquor shops, Rakhine Mote shops and Pork stick shops) with total of 264. Among the roads and streets in Thonegwa, Aung Zayya Road, Min Ye Kyaw Swar Road, Padonmar Road and Thipaw Street have the largest number of food shops.

Grocery shops (including dry goods, rice, vegetable, edible oil, vermicelli, egg) occupied the largest number of food shops. There are totally 80 shops in Thonegwa. Grocery shops are widely distributed within all wards of the town. The largest number of grocery shops can be found in Ward No. 1 and Ward No. 5, but the least number of grocery shops can be found in Ward No. 10. They are more concentrated in Aung Zayya Road, Min Ye Kyaw Swar Road, and Thipaw Street.

Tea shops are the second largest type of food shops. There are totally 36 shops in Thonegwa. Total number of tea shops in each ward are as follows: 8 shops in Ward No. 1, 5 shops in Ward No. 8, 6 shops in Ward No. 4 and Ward No. 9, 2 shops in Ward No. 2, Ward No. 3 and Ward No. 12, and Ward No. 5, 6, 7, 10 and Ward No. 11 have one shop respectively. The largest number of tea shops can be found in Ward No. 1, 4 and Ward No. 9.

The third largest type are betel & cheroot shops. There are 33 betel & cheroot shops and mostly found in Ward No. 1, Ward No. 4 and Ward No. 9, but Ward No. 5, 6, 7, 8 and Ward No. 10 has no betel & cheroot shops. Most of the betel & cheroot shops are concentrated in Aung Zayya Road.

Other types of food shops (cold drink shops, mohinga & salad shops, rice shops, rice & curry shops, fruit shops, liquor shops, rakhine mote shops and pork stick shops) are widely distributed in Aung Zayya Road and the streets of all wards.

Spatial Distribution of Retail Shops by Wards and Streets

Thonegwa composes of twelve wards, nine roads and thirty-five streets. There are 264 food shops of twelve types are found in Thonegwa. Various types of food shops are widely distributed in nine roads and thirty-three streets of all wards.

According to Table (1), Ward No. 4 has the largest number of food shops, Ward No. 1, Ward No. 9 is second, Ward No. 11 is third, Ward No. 12 is fourth. Ward No. 10 has the least number of food shops.

Table 1. Spatial Distribution of Food Shops by Wards in Thonegwa (2019)

Wards	Grocery Shops	Tea shops	Betel & Cheroot Shops	Restaurant	Cold Drink shops	Mohinga, Salad shops	Rice Shops	Rice&Curry shops	Fruit shops	Liquor shops	Rakhine Mote shops	Pork stick shops	Total
Ward No.1	17	8	6	9	1	2			1		1		45
Ward No.2	3	2	1	1		1	1			1		1	11
Ward No.3	2	2	3							1			8
Ward No.4	5	6	12	10	3		4	3	3			1	47
Ward No.5	14	1		1		2							18
Ward No.6	4	1			3	1							9
Ward No.7	7	1			2	4							14
Ward No.8	5	5			4	4							18
Ward No.9	9	6	5	6	2	2	5	5	2	2		1	45
Ward No.10	1	1			1	1			1			1	6
Ward No.11	4	1	3	2	1	2	3	3		2	1		22
Ward No.12	9	2	3		3		1		1	1	1		21
Total	80	36	33	29	20	19	14	11	8	7	3	4	264

Source: Field Survey

The number of food shops in Ward No.4 is 47 shops of 9 types. The largest number and the dominant types of food shops are betel & cheroot shops. They are found in Aung Zayya Road and Anawrahta Road. The second largest shops are restaurants and are mostly found in Aung Zayya Road. The third largest shops are tea shops and mostly found in Aung Zayya Road and Anawrahta Road. Other types of shops are found in Aung Zayya Road, Anawrahta Road and Thiri Street.

Ward No. 1 has 45 shops of 8 types. The largest number of shops are grocery shops which are distributed along Si Thu Road, Thitsar, Kandaw, Myittar Mon streets. The second largest shops are restaurants and mostly found in Thu Kha and Anawrahta roads and Pyi Taw Aye Street. The third largest shops are tea shops and mostly found in Anawrahta Road, Thukha Road, and Marga Road.

Ward No. 9 has 45 shops of 11 types. The largest number of shops are grocery shops. They are found in Aung Zayya Road, Aung Mingalar and Phayon Paing Streets. The second largest shops are tea shops & restaurants and mostly found in Phayon Paing Street. The third largest shops are rice shops and rice & curry shops, and mostly found in Aung Zayya Road and Aung Mingalar Street.

The distribution of food shops in Thonegwa can be classified by wards as follows: grocery shops are concentrated in Ward No.1 and Ward No. 5. Tea shops are found in Ward No.1, Ward No. 4 and Ward No. 9. Other types of food shops are widely distributed in all wards. Therefore, the distribution of food shops by wards in Thonegwa can be said to have multiple type distribution.

Table 2. Spatial Distribution of Food Shops by Roads and Streets in Thonegwa (2019)

Road, Street	Grocery Shops	Tea shops	Betal& Cherroot	Restaurant	Cold Drink shops	Mohinga, Salad	Rice Shops	Food&curry shop	Fruit shops	Liquor shops	Rakhine Mote	Pork stick shops	Total
Aung Zayay Rd.	14	11	18	13	4	1	9		6	2		1	87
Marga Rd.		1		1									2
Thukha Rd.		1	2	1	1			1					6
Min Ye Kyaw Swar Rd.	4	1		1	1	3		2		1	1	1	15
Si Thu Rd.	3	1	1	2			1		1				9
Anawrahta Rd.	3	1	1	2	1							1	9
Tapin Shwe Htee Rd.	1	1	1	1			2						6
Padonmar Rd.	3	2			3	2							10
Bandoola Rd.	1	2				2			1				6
Zayya Theikhti St.		1	1	1									3
Kandaw St.	2	1	1										4
Thitsar St.	3		1										4
Maggin St.	1		1								1		3
Thawka St.	1												1
Yuzana St.	1	2		1									4
Pyi Taw Aye St.		1	1	1		1							4
Myittar Mon St.	1	1				1							3
Kyite Hone (1) St.	2		2	1	1								6
Kyite Hone (2) St.	1		1	1						1			4
Sebei St.	1												1
Zezawah St.													
Kyansitt St.	2	1											3
Thiri St.		1		1									2
Thipaw St.	6	1		1	1	2							11
Zawtika St.	3				1								4
Mindone St.	4					1							5
U Lu Lay St.	2										1		3
Shwe Nyaung Pin St.	1												1
Nga Moe Yeik St.	1	1			1	1							4
Thudamar St.	1												1
Lay Kyun Man Aung St.	1				1								2
U Bu Gyi St.	2				1	1							4
U Thet Tin St.	2	1				1							4
Kar Lann Hung St.	1	2			1	1							5
Phayon Paing St.	2				1	1							4
Myae Myithar st.													
Aung Mingalar St.	2					1							3
Mingalar Kandaw St.	1				1							1	3
Seikkan Thar St.				1									1
Damazayti St.	1	1	1				2			2			7
Shin Saw Pu St.	2	1											3
Myintzu St.	1									1			2
Hnin Si St.	1		1		1								3
Thapyay St.	2												2
Total	80	36	33	29	20	19	14	11	8	7	3	4	264

Source: Field Survey

Generally, all roads and streets of Thonegwa are dominated by various types of shops. This type distribution of food shops by roads and streets can be categorized as multiple types of distribution and single type distribution. Multiple type distribution is wide spread in the whole town. Single type distribution is found in Thawka Street, Sebei Street, Shwe Nyaung Pin Street, Thudamar Street, and Seikkan Thar Street. (Table 2)

Analysis on Spital Distribution of Food Shops in Thonegwa

Analysis on Food Shops by using Lorenz Curve

The Lorenz curve is a useful graphical technique for examining the extent to which a population is concentrated or uniformly dispersed across geographic units.

According to table (3), the largest cumulative difference percentage is geometrically the great vertical distance between the curve and 45 degree line.

The largest number is 39.43 percent in Ward No. 3. The curve is moderately deviated from the 45 degree line because food shops are not uniformly distributed in all wards. Because majority of the food shops are located along the Aung Zayya Road and near Myoma market.

Table 3. Calculation Needed to Plot Lorenz Curve

Wards	No. of Shops	Ward Area (sq Km)	Shop Density	% of Town total		Cumulative % of Total		Cum A - Cum No. of Shops
				No, of Shops	Area	No, of Shops	Area	
Ward No.10	6	1.55	3.87	2.27	21.00	2.27	21	18.73
Ward No.2	11	0.68	16.18	4.17	9.21	6.44	30.21	23.77
Ward No.8	18	1.11	16.22	6.82	15.04	13.26	45.25	32.00
Ward No.9	45	1.8	25.00	17.05	24.39	30.30	69.64	39.34
Ward No.3	8	0.23	34.78	3.03	3.12	33.33	72.76	39.43
Ward No.1	45	0.97	46.39	17.05	13.14	50.38	85.91	35.53
Ward No.5	18	0.27	66.67	6.82	3.66	57.20	89.56	32.37
Ward No.7	14	0.2	70.00	5.30	2.71	62.50	92.27	29.77
Ward No.6	9	0.09	100.00	3.41	1.22	65.91	93.49	27.58
Ward No.12	21	0.13	161.54	7.95	1.76	73.86	95.25	21.39
Ward No.11	22	0.13	169.23	8.33	1.76	82.20	97.02	14.82
Ward No.4	47	0.22	213.64	17.80	2.98	100.00	100.00	
Total	264	7.38	923.51	100.00	100.00			

Source: Based on Table 1

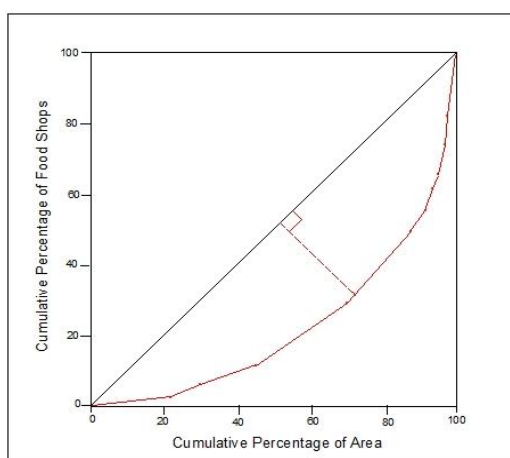


Figure 2. Spatial Distribution of Food shops in Thonegwa

Source: Based on Table 3

Analysis on Spatial Distribution of Food Shops in Thonegwa

In Thonegwa, there are 264 food shops in 2019. The spatial distribution of food shops are analyzed by using Mean Center, Standard Distance and Deviatonal Ellipse methods, and Buffer Zone.

Analysis on Food Shops by using Mean Center, Standard Distance, Deviatonal Ellipse

There are 264 food shops in Thonegwa. Mean center of food shops exist in Ward No. 4. This ward has 47 food shops and exits 213.64 shops per square kilometer. Because this ward is located near the market and the town center. One standard distance for food shops falls between Ward No. 2 and Ward No. 4, 5, 6, 11, 12, especially found on the Aung Zayya Road. Generally, orientation of Ellipse is NNE direction. Ward No. 4, 6, and Ward No. 11 are included within one standard deviation ellipse. Therefore, 68 percentage of food shops are clustered in these wards. (Figure 3.)

Analysis on Food Shops by using Buffer Zone

Based on the concept of proximity, buffering creates two arcs: one arc that is within a specified distance of select features and the other area that is beyond. The area is within the specified distance is called the buffer zone. Buffering around lines creates a series of elongated buffer zones. Buffer zone along the main road is defined by 50 meters away from main roads.

There are 264 food shops in Thonegwa. Among them, 87 shops are found along Aung Zayya Road. Thus 33 percentage of total food shops are concentrated within buffer zone along the main road. About 24 percentage of total food shops along the rest eight main roads and 43 percentage of total food shops along thirty-three streets remain on the outer side of buffer zone. (Figure 4.)

Conclusion

Thonegwa Town is located at the west of Thonegwa Township. It is located at the junction of Hmaw Wun Chaung, Okkan Chaung and Tagaw Chaung. Thonegwa composes of twelve wards, nine roads and thirty-five streets. There are 264 food shops of twelve types are found in Thonegwa. Ward No. 4 has the largest number of food shops, Ward No. 1, Ward No. 9 is second, Ward No. 11 is third, Ward No. 12 is fourth. Ward No. 10 has the least number of food shops.

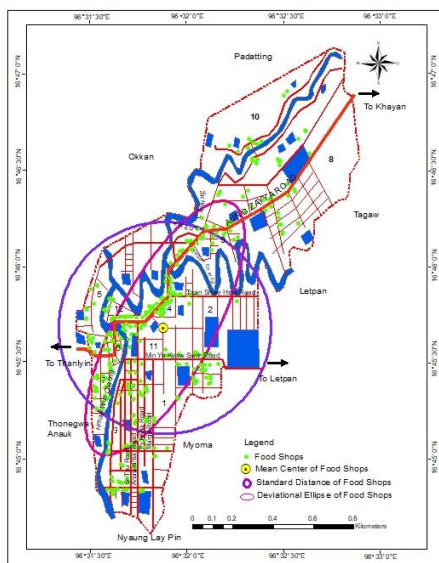


Figure 3. Mean Center, Standard Distance and Deviatonal Ellipse of Food Shops in Thonegwa
Source: Field Survey

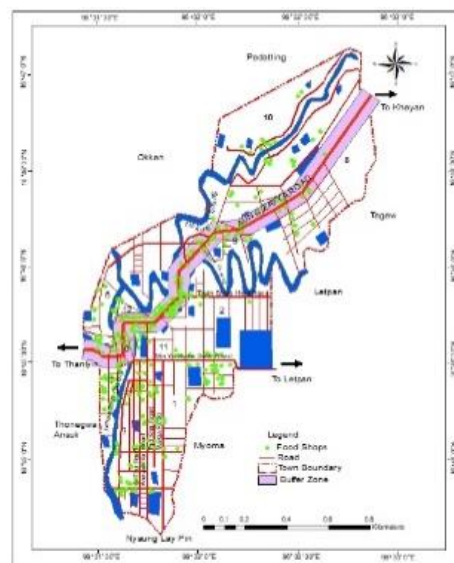


Figure 4. Spatial Distribution of Food shops within buffer zone along the Aung Zayya Road in Thonegwa
Source: Field Survey



Plate 1. Tea Shop at Aung Zayya Road Plate 2. Restaurant at Min Ye Kyaw Swar Road

Various types of food shops are widely distributed in nine roads and thirty-three streets of all wards. The distribution pattern of food shops may be found in two patterns, multiple distribution pattern and single distribution pattern. In general, most of the food shops can be found on Aung Zayya Road, Min Ye Kyaw Swar Road, Padonmar Road and Thipaw Street.

The spatial distribution of food shops is analyzed by using Mean Center, Standard Distance and Deviation Ellipse methods, and Buffer Zone. Mean center of food shops exist in Ward No. 4. One standard distance for food shops falls between Ward No. 2 and Ward No. 4, 5, 6, 11, 12, especially found the Aung Zayya Road. Generally, orientation of Ellipse is NNE direction. Ward No. 4, 6, and Ward No. 11 are included within one standard deviation ellipse. Therefore, 68 percentage of food shops are clustered in these wards. There are 264 food shops in Thonegwa. Among them, 87 shops are found along Aung Zayya Road. Thus 33 percentage of total food shops are concentrated within buffer zone along the main road. Therefore, it could be considered that the spatial distribution is mainly depend on good transportation, town center and bus terminal.

There are some advantages and disadvantages in the spatial distribution of food shops in Thonegwa. Some food shops lie near the government offices and at the corner of the roads and streets. Therefore, some sellers and consumers near roads and streets can face with accident problem. These shops should sale hygienic foods. Moreover, smoke and smell from food shops affect the health condition for people who live near the food shops. The potential fire case from these food shops should be considered. Because some food shops located near residential buildings.

Acknowledgements

We are deeply indebted to Dr. Nay Win Oo, Rector, East Yangon University, Dr. Aye Aye Ko, Dr. Wah Wah Lwin and Dr. Thida Aung, Pro-Rectors, East Yangon University, for their keen interest and for their permission. I wish to record my gratitude to all interviewees in Thonegwa Township and General Administrative Office, Immigration and National Registration Department and Agricultural Land Management and Statistic Department, Thonegwa Township for their great help in the field work. I also thank all my friends, for their help in preparing my work.

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A GEOGRAPHICAL ANALYSIS OF URBAN LANDUSE IN THINGANGYUN TOWNSHIP

Htet Htet Aung*

Abstract

This paper focuses on the “Urban Landuse of Thingangyun Township”. Geographically, its relief is favourable for the development of urban landuse. Ngamoeyeik creek flows like township boundary and change in urban morphology create distribution of landuse patterns. Transportation lines (like Rail Road) interest the study area, residential landuse closely distribute transportation line and market (bazaar) areas. The main aim of this research is to investigate the types and distribution pattern of landuse in Thingangyun Township. The secondary data with respect to landuse in the study area are also analyzed in this research. In doing this research work, GIS techniques are used. This paper can partially contribute to accomplish more successful landuse plan in Thingangyun Township.

Keyword: Urban Landuse, relief, urban morphology, transportation lines

Introduction

Thingangyun Township is one of the 45 townships of Yangon Region and includes in the East Yangon District. It lies between North Latitudes 16° 48' 30" and 16° 52' 20" and between East longitude 96° 10' and 96° 13' 15". It is bounded by South Okklapa on the north, Dagon Myothit (South) on the east, Thaketa and Dawbon townships on the south and Yakin and Tamwe townships on the west. The area extent of the township is 11.4 square kilometer (4.4 square miles), comprising 38 wards. Figure (1 and 2). The relief of Thingangyun Township is low and flat with a general elevation of about 6.2 metres (20ft) above sea level. The land gently slopes towards the Ngamoeyeik Creek. The Ngamoeyeik Creek is a major drainage which flows as the eastern and southern boundaries. It rises in Bago Yoma, first as Palaung Creek and then as Ngamoeyeik Creek when it flows through Hlegu Township. Geologically, Thingangyun Township is covered with thick young alluvium, underline by rocks of Irrawaddy formation. The study area, as in other most townships of Myanmar, experiences Tropical Monsoon Climate (Am). The dominant soil types of the study area are swampy meadow soils and meadow grey soils. Tropical evergreen and tropical deciduous forest might have covered the area before the area was occupied by permanent settlement. Some species of tidal forest are found scattering along the Ngamoeyeik Creek and its tributaries. The population of Thingangyun Township was 188287 persons in 2011 and it increased to 212252 persons in 2016. The average annual growth rate in the 2011-2016 period was 2.02 percent.

The aim of the study

The main aim of this research is to investigate the types and distribution patterns of landuse in Thingangyun Township.

The objective of the study

- To examine the physical and social factors which are related to different types of landuse in the study area and to present the controlling factors over the current landuse types of the study area.

Data and Methodology

Both primary and secondary data are used. The primary data are collected from local inhabitants and field surveys. Secondary data are obtained from Meteorology and Hydrology Department, Administration Offices of Thingangyun Township and Urban and Town of YCDC and Arc GIS 10.1 software is used for landuse classification analysis.

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Figure(2): Wards Pattern of Thingangyun Township

Township

Classification of Landuse Types

Table 1 Landuse Types of Thingangyun Township (2016)

No.	Type of Landuse	2016	
		Area(Sq Km)	Percent
1	Residential landuse	10.13	90.43
2	Landuse for primary production	0	0
3	Industrial landuse	0.17	1.49
4	Commerical Landuse	0.08	0.73
5	Land Used for Services	0.04	0.35
6	Land used for Public and Government Departments	0.65	5.7
7	Recreational Landuse	0.04	0.35
8	Landuse for municipal Services	0.02	0.17
9	Transportational Landuse	0.08	0.7
10	Unused Land	0.01	0.08
	Total	11.4	100

Residential Landuse

Land used for Primary Production

There is no land classified as farmland in Thingangyun Township. A few vegetables grow in the small vacant plots and beside the railroad.

Industrial Landuse

The land area used for industries is 0.17 square kilometre or 1.49 percent. Manufacturing plants and factories are found in Ka, Kha, Khagwe, Gagyi, Nga Ka, Nga Khagwe, ward 29 of Thuwana, Aungsupan and Zagwe north wards. The most common ones are blanket factory, oil-mill, rope making factory, saw-mill, fish-freezing factory, rubber factory, curry powder mill, lime factory, pulses splitting factory. These are one state-owned factory and fifteen private-owned factories. Figure (3)

Commerical Landuse

In Thingangyun Township, the land area used for commerce is 0.08 square kilometre or 0.75 percent, including mostly market places and wholesale and retail shops. These shops are mixed with residential buildings. There are 5 markets in the study area and there are Thingangyun Market on Laydaukkan road in U San Pe Ward, Thuwana Market on Thanthumar road in Ward No (29), Yenanthar Market on Thanthumar road in Ward No (24), Ngamoeyeik Sanpya Market between Laydaukkan and Thanthumar roads, and Yantannar road in Ward 16/2. A wide variety of shops are found on both sides of the main roads, using the ground floor of residences. Figure (3)

Land Used for Services

In Thingangyun Township, 0.04 square kilometer or 0.35 percent of land is used for services. Service activities are greater in number and diverse in nature. They are found mostly attached with residential buildings along the main roads. Figure (3)

Land used for Public and Government Departments

The area of land used for public and governments departments is 0.65 square kilometre or 5.70 percent. For public use, there are 5 B.E.H.S, 4 B.E.M.S, 35B.E.P.S and 5 monastic schools. Government departments are Township General Administration Office, Township Police Station, Township Education Office, Township Health Centre, Township Fire Brigade Office, Township Law Office, Township Housing Office, Township Accounting Office, Township Post Office, Township Immigration Office, Township Custom Office, Township Communication and Transportation Office, Township Cooperative Society Office, Township Electricity Office and Township Planning Office. Besides, there are several non-government organizations, including Women Affairs Association, Child and Maternal Care Association, Veteran Association, Red Cross Society and Fire Brigade. The township has 5 famous pagodas, 182 monasteries and 23 nuneries, Kyaikkasan Pagoda is the most well-known and it is located in Sa Khagyi ward occupying 30.7 acres of land. Beside Buddhist religious buildings, the township also has one Christian Church, 10 mosques, and 18 Hindu temples. Mosques and Hindu temples are located in Khagyi, Khagwe, Ganga, Kgagyi, Nga Khagyi, and Nga Khagwe Wards. Figure (3)

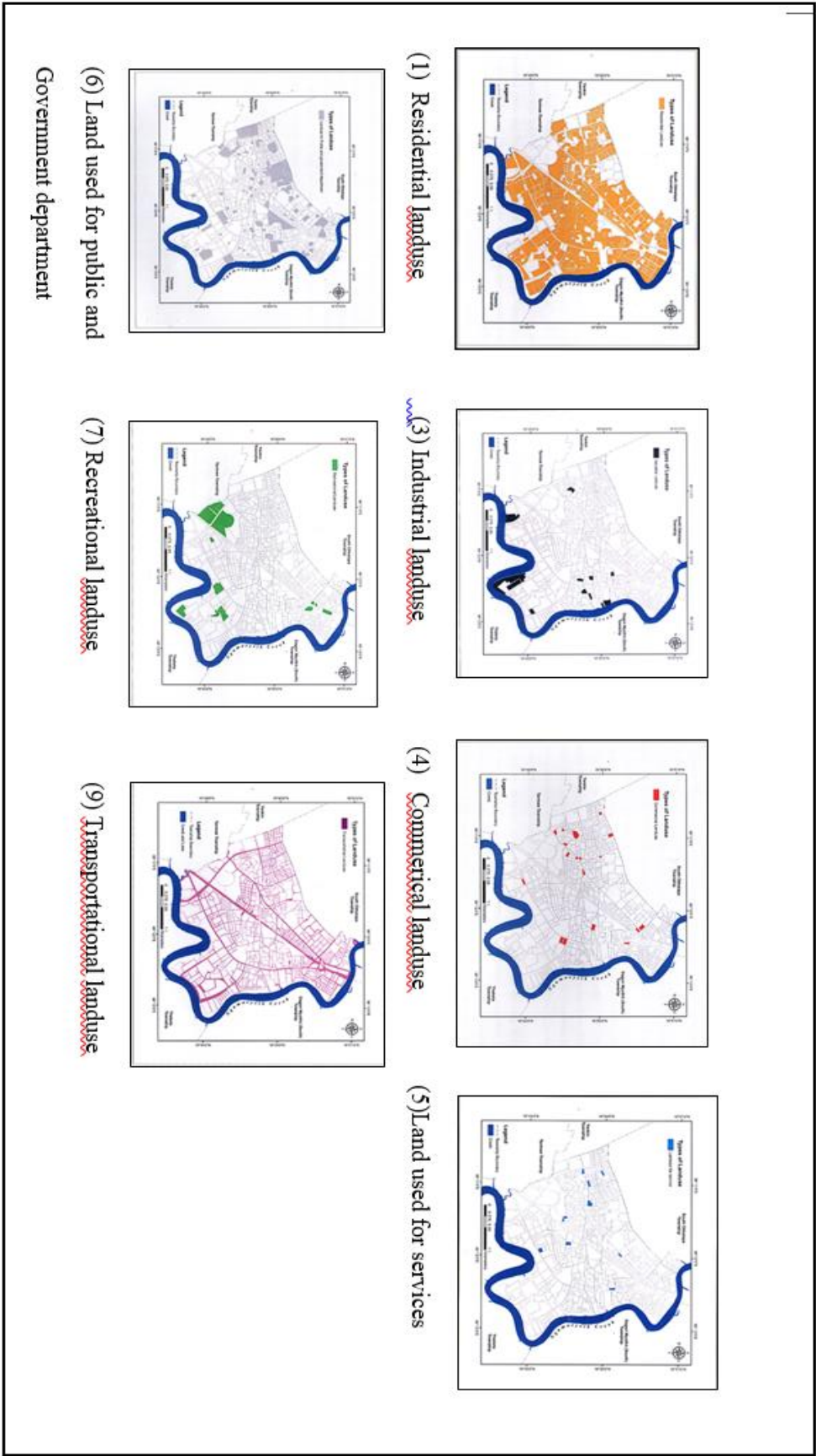
Recreational Landuse

The land area used for recreation in Thingangyun Township is 0.04 square kilometer or 0.35 percent. The township has one playground and one gymnasium. Thuwana Park is located in No (29) Ward of Thuwana Town beside Thanthumar main road. The playground and gymnasium are located on both sides of Waizayantar main road in Thumingalar ward. Leikpyar Lake, which is also useful for recreation, is located at the junction of Laydaukkan main road and U Ba Han Road. Figure (3)

Municipal Landuse

The land area occupied by municipal land area is 0.02 square kilometer or 0.17 percent. There are a number drains for the disposal of liquid wastes as sewage and most drains measure $3\frac{1}{2} \times 6'$. Iron boxes used as solid waste tanks are placed beside the main roads. Drinking water and water used for domestic purposes are acquired from the pipeline water supply system of Ngamoeyeik Reservoir and the tube-wells. Several electric sub-stations and transformers also use separate plots of land and roadside land for the transmission of electric power. Figure (3)

Figure (3): Distribution of Ten landuse types in Thingangyun Township



Transportational Landuse

Transportational landuse occupies 0.08 square kilometer or 0.70 percent of land. The main transportation routes are Laydaukkan road, Thanthumar road, Thumingalar road, Waizayantar road and Kamarkyi road. Except Waizayantar road is used for private transportation. The study area also has railroad which runs across the western part of the township and the trains stop at Thingangyun, Hninsigone, and Ngamoeyeik stations. Figure (3).

Unused Land

There is 0.04 square kilometre or 0.08 percent of land that remains unused for any purpose. The former century located in Gange Ward now is unused land.

The landuse of Thingangyun Township is highly dominated by residential land which occupies more than 90.4 percent of the township area. Geographically, its relief is favorable for the development of urban landuse. As the underling rock layer is mainly of alluvium, high-rise buildings with more than 15 stories are not recommendable. The road network of the township indicates that the town morphology has evolved gradually, but not under well-laid plan with grid system of roads. There is still pirate settlement or squatting on vacant plots of some wards and beside the rail track. As there are still some industrial activities within the residential area, noise pollution, bad smell and industrial wastes cause great disturbance to town dwellers. The existing pirate settlement should be removed and relocate at a suitable place. Likewise, the industries within the Wards of the study area should be allocated at a nearest industrial zone. Other types of landuse cannot be changed to achieve the best uses of the land in the study area, as they have been formed for a long time. Thingangyun Township occupies the eastern lowland part of Yangon City, fronted by the Ngamoeyeik and Baukhtaw Creeks. Much of the land is low, flat plain with a general elevation of about 20 feet above sea level favorable for permanent settlement. Flat lowland poses less difficulty in road construction which is usually manifested by the layout controlling the internal structure of the town. However, the Ngamoeyeik Creek are inundated in the rainy season and thus not favorable for settlement. Although the presence of Ngamoeyeik and Baukhtaw Creeks were favorable for the shipment of freight and passengers when the roads were less developed, it has separating effect and restricts the movement unless the bridges are constructed over the creek. Geologically the uppermost layer is thickly covered with alluvium, causing difficulty in laying foundation of heavy high-rise structures, particularly multi-story building. Social factors as education, health and religion are important as they share much the land. In the beginning the study originated itself by grouping of settlement units. Over time it has development into a village, then a large village and eventually a town. In the first phase of development the morphology of the town was less concerned with government. However, development in later period was highly dictated by the government plan or instruction. Without government permission, high-rise multi-storey building cannot be constructed. Among the institutional factors, government policy is the most important the landuse patterns and urban landscape of the township.

Conclusion

Thingangyun Township is included in Eastern Yangon District and its elevation ranges 20 feet above sea-level, favorable for human habitation. Being part of the urban area of Yangon City, much of the land 90.43 percent is used for residential purpose. Other landuse types come into existence to fulfill the needs of the residents. The total population of the township is 212252 in 2016 and settlement units are more clustered in the southwestern, eastern and northern parts. Next to residential landuse, the public and government landuse occupied the largest area, but accounting for only 5.70 percent of the township area, followed by industrial

landuse 1.49, and commercial landuse 0.73 percent. However, the area occupied by commercial landuse is rather vague and complex, as most small-scale commercial activities are carried out at the ground floors of the ground floors of the residential unit, but in great number and most diverse forms.

Acknowledgements

I would like to acknowledge Dr Nay Win Oo, Rector, East Yangon University, and Dr Aye Aye Ko, Dr Wah Wah Lwin, and Dr Thidar Aung, Pro-Rectors, East Yangon University, Dr. Nyein Nyein Win, Professor & Head of Department, Department of Geography, East Yangon University, for their construct suggestions, for the manuscript. I would like to thank the editors of the East Yangon University's Research Journal for their critical reading. I also thanks Township Administrative Department and YCDC Urban and Town Planning Department.

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A GEOGRAPHICAL STUDY ON DOMESTIC USE OF WATER IN KYAUKTAN TOWN

Yadanar Chan Myae Nyein¹, Daw Thet Thet Oo²

Abstract

This paper presents A Geographical Study on Domestic Use of Water in Kyauktan Town which emphasizes on the water availability, water sources and per capita water consumption. The main aim of this research is to identify the extent of domestic water insufficiency and to analyze the quality of water for domestic uses. The spatial and seasonal water shortage problem of the town and quality of available water are the main research problems. They have to depend on municipal water, pond water, groundwater of tube-well and rainwater in the raining season. This study identifies the main causes and extent of water shortage problem and presents the effective ways to be able to contribute by non-government organization for the problem mitigation. Finally, practicable means for the availability of sufficient, clean and safe water are recommended to somewhat reduce the spatial and seasonal water shortage problem.

Keyword: water consumption, water quality, water sources, domestic use of availability of sufficient, clean and safe.

Introduction

Kyauktan Town occupies Southern Yangon Region of Yangon City. It lies between North Latitude 16° 25' and 16° 43' between East Longitude 96° 15' and 96° 40'. It is 28.97 kilometers (18 miles) away from the downtown area of Yangon City. The central northeast part of the town has a general elevation of about 15.25 meters (50 feet) above sea level, being the southeast continuation of Thanlyin-Kyauktan ridge. Generally, the land slopes towards the west to the Yangon River and towards the south to the Hmawun Creek. The difference in elevation results in the variation of groundwater level, proven by the varying depths of tube wells. Kyauktan lies in the northern part of Gulf of Mottama and it is mainly composed of rocks and soils belonging to upper Pegu Group of Oligocene to Miocene age and Alluvium deposit of Quaternary age. The maximum and minimum temperatures, the monthly mean temperature is highest in April with 30.71 °C (87.28 °F) and lowest in January with 24.75 °C (76.55 °F). The highest temperature in the summer months increase the rate of evaporation, decreasing the existing surface wells, ponds and stream waters. The average annual rainfall is 2900 mm (114.17 inches) and much of the rain is received from the moisture-bearing southwest summer monsoon wind. The amount of rainfall is high in the period from May to October and highest in July with 665.4 mm (26.19 inches). The main aim of this thesis is to identify the extent of domestic water insufficiency and to analyze domestic water quality.⁷

The main objectives are to examine the existing water sources and water quality, to examine the difficulties of the inhabitants in acquiring domestic water and to analyze the average per capita consumption. The ward-wise population density in 2019 is presented in Table 1. Among the nine wards of the town Middle Ward, Sinkan Ward and Shwegone Ward were highest in population density with 18,285 persons, 12,646 persons and 19,040 persons per square mile (7,111 persons, 7,323 persons, 4,869 persons per square kilometer) respectively. These wards have locational advantage, high accessibility and concentration of commercial activities. The population density was lowest in Thidarmyng and Ayemyathida with 263 and 26 persons per square mile (102 and 110 persons per square kilometer) respectively due to extension of new wards. Both types of data, primary and secondary data are used in this study. Domestic water use is examined after collection of primary data by interview method.

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Systematic random sampling method is used for distributing questionnaires. Water quality is tested in laboratory, including pond water, tube well water, surface well water by two times in the dry season and wet season.

Table 1 Population Distribution and Density of Kyauktan Town (2019)

No	Wards	Number of Population	Number of Households	Area		Density (per sq-km)
				Square Miles	Square Kilometers	
1	Eastern	2930	728	1.36	3.52	832
2	Middle	1280	256	0.07	0.18	7111
3	Western	4753	1103	1.06	2.75	1728
4	Shwegone	8473	1995	0.67	1.74	4869
5	Sinkan	5712	1380	0.30	0.78	7323
6	Sanchinhmi	5526	1395	0.99	2.56	2159
7	Thidarmying	2087	567	7.92	20.51	102
8	Ayemyathidar	1200	356	4.21	10.90	110
9	Shwepyitharyar	3042	716	3.08	7.98	381
	Total	3,5003	8,496	19.66	50.92	24614

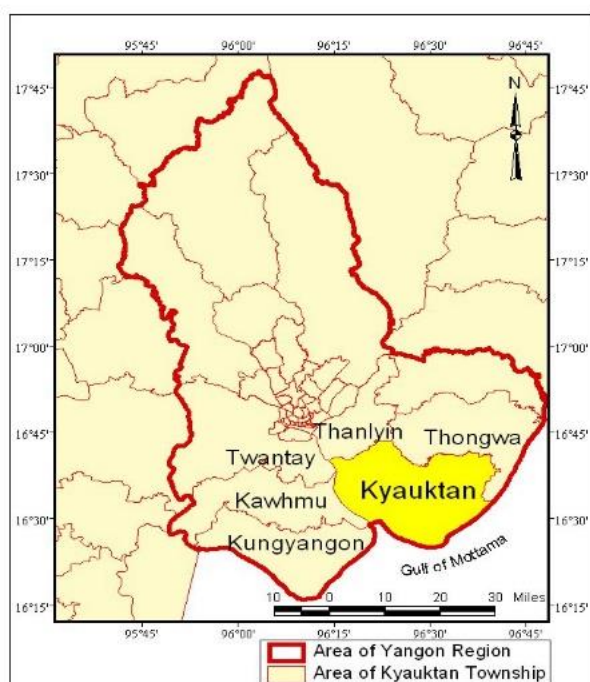


Figure 1. Location of Study Area in Yangon Region

Source: Based on Topographic Map, Survey Department, Yangon Region

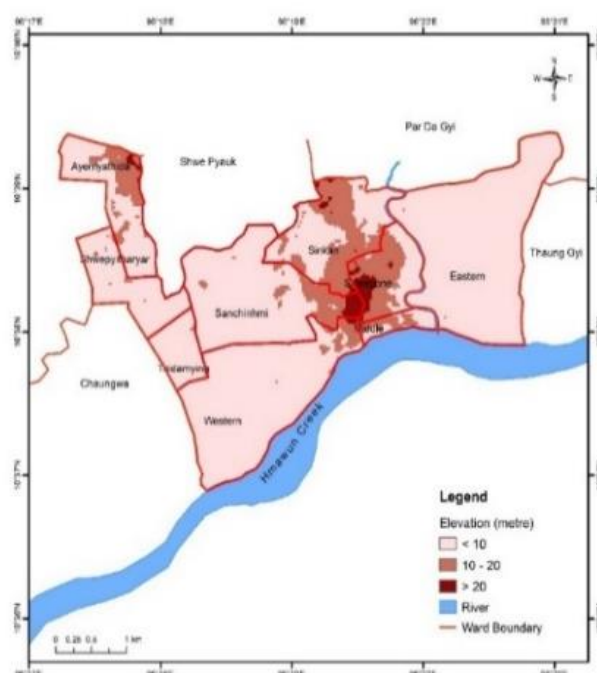


Figure 2. Relief and Drainage Map of Kyauktan Town

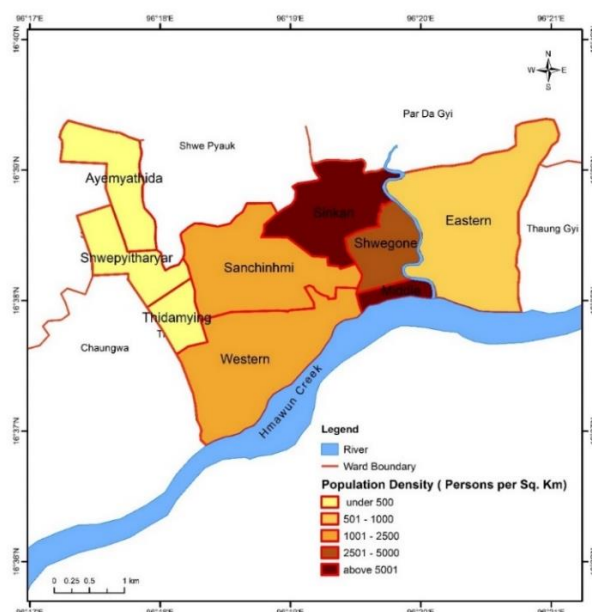


Figure 3 Population Density of Kyauktan Town (2019)

Source: Based on Table 1

Findings and Discussions

Water Sources and Water Quality

The water sources in Kyauktan town are rainwater, stream water, pond water and groundwater (surface well and tube well). These sources are differentiated between surface water sources and groundwater sources. Surface water (ponds) are generally turbid and usually contaminated with domestic and industrial wastes making it bacteriologically usually unsafe. However, it is usually low in chemical contaminated. The surface water was tested two times; once on 11.5.2020 and again 27.7.2020. Groundwater (surface wells and deep tube wells) are usually clear and generally bacteriologically safe, but chemical contamination is comparatively higher than rainwater and surface water. For water quality test 7 sample points are systematically selected from 2 different water sources – pond and tube-wells including 3 from pond water, 3 from tube-well and 1 from surface well. The sample waters taken from one shallow tube well and three deep tube wells were tested taken two times on 11.5.2020 and 27.7.2020. The analysis of variation in the quality of water taken from different sources, based on WHO and NHL Myanmar standards are presented in Table 2. They are grouped into 2 classes. Table 3 shows the test results of water quality checked by WHO standard and Table 4 reveals the test results determined by NHL Myanmar standard.

Table 4 Analysis on Test Results with NHL Standard (2020)

Class	Total Samples	Water Sources Samples	parameters	Remarks
1	3	S ₁ , S ₂ , S ₃ (P ₁ , P ₂ , P ₃)	Within the range of NHL standard	Best quality
2	4	S ₄ , S ₅ , S ₆ , S ₇ (T ₁ , T ₂ , T ₃ , T ₄)	2 parameters not within the range of NHL standard	Fair quality

Source: These samples were tested by YCDC's Laboratory. Based on samples tested by YCDC's Laboratory.

Note: WHO = World Health Organization, NHL= National Health Laboratory



Plate 1 Sinkan Pond in Sinkan Ward of Kyauktan Town

Source: Field Observation (photo taken by author 18.3.2020, 3:19 PM)

Note: Sinkan Pond which supplied water to six wards however it is dry up and contaminated in the dry season



Plate 2 Deep Tube Well of Shwegone Ward in Kyauktan Town

Source: Field Observation (photo taken by author 18.3.2020, 12:00 PM)



Plate 3 Surface Well of Shwegone Ward in Kyauktan Town

Source : Field Observation (photo taken by author 18.3.2020, 12:20 PM)

Note: This brick lined surface-well is a private well in Shwegone Ward. It used water for domestic use.

Table 3 Analysis on Test Results with WHO Standard (2020)

Class		Total Samples	Water Sources Samples	parameters	Remarks
1		3	S ₁ , S ₂ , S ₃ (P ₁ , P ₂ , P ₃)	1 or 2 parameter outside the range of WHO standard	Fair quality
2		4	S ₄ , S ₅ , S ₆ , S ₇ (T ₁ , T ₂ , T ₃ , T ₄)	2 parameters not within the range of WHO standard	Fair quality

Source: These samples were tested by YCDC's Laboratory. Based on samples tested by YCDC's Laboratory.

Ranking of Water Consumption by Sources

The amount of water consumption varies among the households depending on the water sources and variations in socioeconomic levels. There are 6 different sources of water in Kyauktan Town and there are: (1) rain water, (2) surface wells, (3) deep tube-wells, (4) water supply of Township Development Committee (taken from pond), (5) pond water and (6) others. Most households use rainwater in the rainy season. According to questionnaire survey, all the 982 sample households consume rainwater in the rainy season. To be able to use rain water throughout the year particularly for drinking, a number of households store rainwater with large glazed earthen jars. However, some households cannot store sufficient water.

Table 2 The Results of Water Quality from Different Sources in Kyauktan Town (2020)

Sample	Summer										Rainy Season									
	pH	TDS	Total Hardness	Total Alkalinity	Calcium	Magnesium	Chloride	Sulphate	Total Iron		pH	TDS	Total Hardness	Total Alkalinity	Calcium	Magnesium	Chloride	Sulphate	Total Iron	
S1	8.5	195	55	4.0	20.0	1.4	60	Nil	0.2		6.0	14.1	40	40	8.0	5.6	30	Nil	Nil	
S2	8.7	165	45	30	4.0	2.8	30	Nil	Nil		6.8	160	40	40	8.0	2.8	30	Nil	Nil	
S3	7.9	163	45	40	18	2.8	40	Nil	0.1		7.0	245	100	50	120	19.6	45	Nil	Nil	
S4	6.0	210	50	60	12	5.6	55	15	Nil		6.0	135	30	35	12.0	2.8	35	Nil	Nil	
S5	8.1	145	40	30	14	1.4	40	Nil	Nil		6.8	157	50	55	120	5.6	30	Nil	Nil	
S6	6.4	216	70	80	6.0	2.8	60	Nil	Nil		7.4	150	45	35	14.0	2.8	40	Nil	Nil	
S7	7.4	180	50	40	30	5.6	60	Nil	0.1		7.8	245	120	40	14.0	24	25	Nil	0.1	

Source: The sample were tested by YCDC's Laboratory

Spatial Variation in the Water Sources

Although the town has 6 different types of water sources, not all the wards have these sources. The existing sources range between 3 and 6. Eastern Ward and Shwegone Ward have 6 sources, followed by Sanchihmi and Sinkan wards with 5 sources, Western, Middle, Ayemyathida and Shwepyitharyar wards with 4 sources, and Thidamyang Ward with 3 sources which include rain water, pond water, and others.

Table 5 Water Consumption by Sources, (2020)

No	Wards	Questionnaire Households	Sources of Water					
			R	D.T	S.W	K.T.D.C	P	Others
1	Eastern	89	89	42	9	69	14	15
2	Middle	34	34	5	19	25	-	19
3	Western	136	136	-	-	124	71	82
4	Shwegone	180	180	157	98	162	29	18
5	Sinkan	169	169	153	90	349	-	16
6	Sanchihmi	171	171	-	112	158	34	20
7	Thidamyang	70	70	-	-	-	24	64
8	Ayemyathida	46	46	39	5	-	6	12
9	Shwepyitharyar	87	87	55	12	-	-	24
	Total	982	982	451	345	763	178	270

Note:

R = Rainwater K.T.D.C = Kyauktan Township Development Committee

D.T = Deep Tube Well P = Pond Water S.W = Surface Well

Other= Purchase and donation

Source: Questionnaire Survey, 2020

Distribution of Each Source of Water Consumption

According to the responses of 982 sample households, all the households depend on rainwater in the rainy season for domestic uses and drinking. In Kyauktan Town 6 out of 9 wards have a number of deep tube wells and these are Eastern, Middle, Sinkan, Shwegone, Ayemyathida and Shwepyitharya wards. Among the sample households, 46 percent use deep tube well water for domestic uses. The surface water is used in 7 out of 9 wards and these are Eastern, Middle, Shwegone, Sinkan, Sanchihmi, Ayemyathida and Shwepyitharyar wards. Western and Thidamyang wards have no surface well because the groundwater is salty. Among the 982 sample households 345 (35%) use surface well water. The use is highest in Shwegone and Sanchihmi wards. Township Development Committee pumps out water from Sinkan pond and delivers to the 6 wards of the town with pipeline system. Sinkan pond is of earth type and its water storage capacity is 81.8 million gallons with 44 acres. Thidamyang, Ayemyathida and Shwepyitharyar are nearly extended wards and thus these wards have no access to KTDC water. Out of 982 sample household 763 (78%) receive water released from KTDC source. There are 23 ponds in Kyauktan Town. The study area has 982 households of which 178 households (18%) use pond water and 270 households (27%) that depend on purchase water.

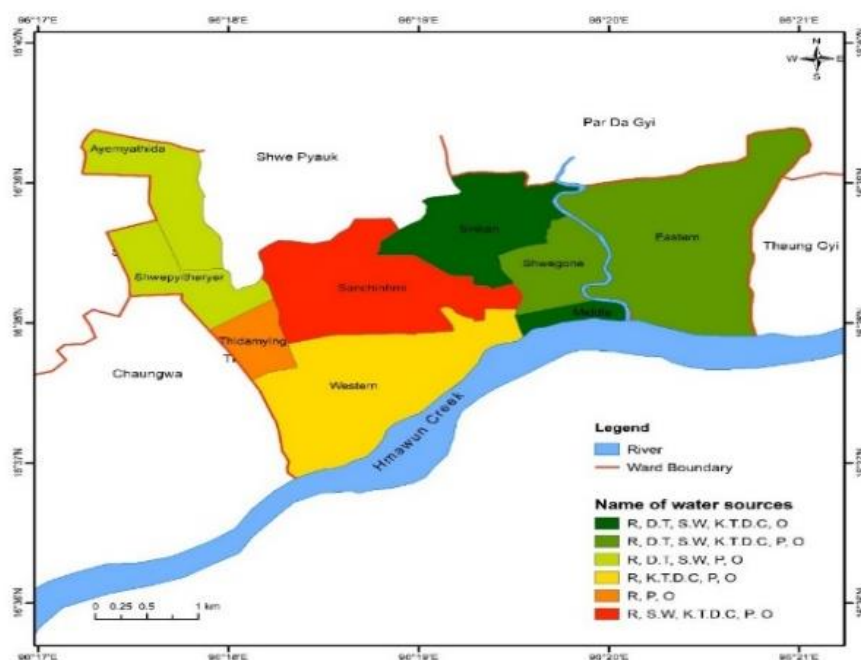


Figure 4 Spatial Variation in the Water Sources in Kyauktan Town

Types of Water Consumption by Sources

Depending on the type of water it is mostly used for (1) drinking (2) cooking and (3) bathing and washing. The different uses are presented in Table 6, based on the responses to the questionnaires.

Temporal Variation in Daily Per Capita Water Consumption

(a) Rainy Season

Ward wise sample size, population, per capita water consumption per day in the rainy season and summer are presented in Table 7. The table shows that per capita water consumption per day in the rainy season is highest in Shwegone Ward with 143.83 liters (38 gallons). Generally the residents living in the western and eastern parts of the town consume more water than that the northern part due to heavy a number of surface well and being available of K.T.D.C water.

(b) Summer

The daily per capita water consumption in summer ranges between 56.785 and 121.112 liters (15 and 32 gallons). It is highest in Shwegone Ward with 121.112 liters (32 gallons), followed by Sinkan and Sanchihmi wards with 113.55 liters (30 gallons), Eastern Ward with 94.625 liters (25gallons), Middle Ward with 83.27 liters (22 gallons), Western and Thidarmyng wards with 75.7 liters (20 gallons), Ayemyathida Ward with 68.13 liters (18 gallons) and Shwepyitharyar Ward with 56.775 liters (15 gallons).

Generally per capita water consumption per day decreases notably in summer, being unable to get rain water. The low per capita water consumption in Shwepyitharyar Ward is on number of low incomes having no enough money to purchases water sufficient, especially in summer.

Table 6 Types of Water Consumption by Sources in Kyauktan Town, (2020)

Source of Water	No.	Sample Size (households)	Types of water	Types					
				Drinking Water		Cooking Water		Bathing and Washing	
				households	%	households	%	Households	%
Rain Water	1	982	Rainwater storage in large earthen pots	982	100	982	100	982	100
Surface Water	1	178	Pond water	45	25	178	100	178	100
	2	763	K.T.D.C	657	86	763	100	763	100
Ground Water	1	345	Surface well	228	66	345	100	345	100
	2	451	Deep tube well	338	75	451	100	451	100
Others	1	270	Purchase & donation	249	92	208	77	198	73

Note: K. T. D. C. = Kyauktan Township Development Committee

Sources: Questionnaires Survey, 2020

This paper is essentially to identify the extent of spatial and seasonal domestic water insufficient and to analyze domestic water quality in Kyauktan Town. Spatial variation in the daily per capita water consumption in 9 wards of the study area is 15-32 gallons in summer and 25-38 gallons in rainy season. The daily household water consumption of Shwegone Ward is 38 gallons rainy season and 32 gallons in summer. The study area has 9 wards of which only 6 wards have access to K.T.D.C water. The remaining 3 wards, Ayemyathida, Shwepyitharyar and Thidarmying are extended wards and have no access to the pipeline system of K.T.D.C. Usually Thidarmying Ward receives water donated by Thilawar Industrial Zone and thus water shortage problem is not actuated. The two wards have to depend on the surface well water which gradually reduces in the dry season. Most households of these wards cannot afford to sink a tube well and have to purchase water or share water from the households that have own tube well. The pipeline system of K.T.D.C is extended to these wards, it will, to some extent, solve the problem. If the government or a certain organization sink several community surface-wells, the water shortage problem will be less pronounced. Kyauktan Town has 23 ponds and a number of households use pond water. However, some ponds dry up in summer, due to being shallow, filled with sediments. These ponds should be dry deeper to store more rainwater. The main annual rainfall of the study area is 2900 mm. The locals store rain water with earthen jars to be used as drinking water in the dry season. However, the low-income households have to buy purified drinking water, costing more expense. If more ponds are dry and large brick tanks are built for storing rainwater, the locals will witness less drinking water shortage problem and there will be no water-born diseases.

Table 7 Spatial Temporal Variations in the Daily Per Capita Water Consumption in Kyauktan Town, (2020)

No.	Wards	Sample Size (households)	Population	Rain Season		Summer	
				T.g.p.d (gallons)	P.c.p.d (gallons)	T.g.p.d (gallons)	P.c.p.d (gallons)
1	Eastern	89	407	13,024	32	10,175	25
2	Middle	34	143	4,290	30	3,146	22
3	Western	136	474	14,220	30	9,480	20
4	Shwegone	180	804	30,552	38	25,728	32
5	Sinkan	169	784	27,440	35	23,520	30
6	Sanchihmi	171	948	33,180	35	28,440	30
7	Thidarmying	70	400	12,000	30	8,000	20
8	Ayemyathida	46	273	6,825	25	4,914	18
9	Shwepyitharyar	87	450	11,250	25	6,750	15

Note: T.g.p.d = Total gallons per day

P.c.p.d = Per capita per day

Source: Questionnaire Survey, 2020

In 2015, the study area had 33,821 persons and consumed 618,924 gallons of water in summer and 1,305,491 gallons in rainy season in 2019. The increases of population in the 4 years period was 35,003 persons. At this rate, in the next 5 years in 202,436,503 people will increase. As a results, 65,935 more gallons in summer and 1,409,016 more gallons in rainy season will need for the town. Therefore, the township development committee should have feasible plans to be able to provide more water to the residents. The existing sources, Banbwegone reservoir (Kyauktan township) and Sinkan pond should be properly maintained as well.

Conclusion

The research is essentially based on field survey, response to the questionnaires from 982 households, discussions with the staff concerned and with some local residents and the results of physicochemical testing in addition to the secondary data obtained from the departments concerned.

These are (1) rainwater, (2) streams water, (3) pond water, (4) surface well, and (5) deep tube well and (6) Kyauktan Township Development Committee. Generally, rainwater is the chief source in the rainy season and pond water (K.T.D.C) plays the most important role in the dry season for water consumption in the study area.

A problem that “There is spatial and seasonal water shortage problem in the hot dry season in Kyauktan Town” has been stated at the beginning of this paper. It is generally accepted that the need of per capita daily consumption of water varies between 40 to 200 liters (10.6 to 52.8 gallons) depending the living standard.

Acknowledgements

I would like to acknowledge Dr Nay Win Oo, Rector, East Yangon University, and Dr Aye Aye Ko, Dr Wah Wah Lwin, and Dr Thidar Aung, Pro-Rectors of East Yangon University, Dr.Nyein Nyein Win, Professor & Head of Department of Geography, East Yangon University, for their construct suggestions, for the manuscript.

I would like to thank the editors of the East Yangon University's Research Journal for their critical reading. Lastly, thanks are due to the officers as well as the office staff of Township General Administrative Office, Ward Administrative Office, Kyauktan Township Development Committee and Immigration and National Registration Department of Kyauktan Township for their kind assistance in compiling the chapters related to their respective fields of study.

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GEOGRAPHICAL ASSESSMENT ON SOIL DEGRADATION IN THANLYIN TOWNSHIP

Su Myat Hay Mar Thein *

Abstract

This research presents a study on soil degradation in Thalyin Township from geographical point of view. Thalyin Township is situated in the Southern District of Yangon Region. Thanlyin Township comprises 17 quarters and 28 village tracts. Thanlyin Township of soil degradation processes includes loss of nutrients and organic matter, salinization, acidification, pollution, compaction and subsidence. Studies reviewed have shown that the widespread degraded upland soils possess chemical and physical processes Key word: soil degradation, chemical processes and physical processes, natural processes and human activities.

Introduction

Thanlyin Township is situated in the Southern Yangon District. It is located on the left bank of Bago River and close to the Yangon City. It lies between north latitudes 16° 40' and 16° 59' and east longitudes 96° 13' and 96° 25'. It is surrounded by Thongwa Township and Khayan Township on the east, Kyauktan Township on the south, the Yangon River on the west and the Bago River on the northwest.

The total area of Thanlyin Township is 383.3sq-kilometres (9216.51acres) and it comprises about 3.8 percent of Yangon Region. Thanlyin Township can be divided into two parts i.e urban area (Thanlyin Town) and rural area. Thanlyin Town, the urban area, is comprised of seventeen wards. The rural area is comprised of twenty-eight village tracts. The area of town is 15.39 sq-kilometres (3803 acres) and the area of village tracts is 357.52 sq-kilometres (88345 acres). The shape of the township is elongated.

The study area, Thanlyin Township, is located between Ayeyarwady delta region and Sittaung delta region and hence it is part of the Rice Bowl area of Myanmar. Its situations lying on flat alluvial plain, having hot and wet climate and alluvials soils of deposited origin, all favour the growing paddy, beans and various crops in commercial scale.

There are seven types of soil in the study area. Most of them have been continuously used as paddy farming for hundreds. Field survey is done for data collection and fact finding. The study area, Thanlyin Township lies in the southern part of Yangon Region. The study area is located across Bago River from the city of Yangon. It's located 3 miles away from river mouth in which Yangon River, Bago River and Pazundaund Creek converge. Thanlyin Township comprise 17 quarters and 28 village tracts.

The study area of the Thanlyin Township is affected by the soil degradation. As the study area lies between of Ayeyarwaddy and Sittaung deltaic areas, topography of Thanlyin Township is generally a flat low land. On the west, Thanlyin-Kyauktan Lateritic ridge with low relief runs roughly from west-northwest to east-southeast. The highest point of the ridge is Kyeik-Kyauk Pagoda which is 40.54 metre (133 feet) high above mean sea level.[†]

Most part of the township is below 10 metres above mean sea level. The lowest portion is the Bago River bank. The major rivers are the Bago River and the Yangon River. The Bago River flows along north and north west border between Thanlyin and Dagon (Myothit)

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Seik-kan Township of Yangon Region. The Yangon River flows along western border toward Kyauktan Township and then enters the Gulf of Mottama. Some small streams having their source on the ridge flow slowly through the wide plain and enter either the Bago River or Khayan Chaung. As Thanlyin Township is humid tropical climate.

Aim and Objectives

The aim of the study is to evaluate the impact of soil degradation
The objectives are of the study are as follows:

- a. To examine the current types of soil degradation in the study area;
- b. To identify the main causes of soil degradation in the study area;
- c. To investigate the current major practices of land management in the study area.
- d. To analyse the various processes of soil erosion and different degradation.

Source of Data and Methodology

Data are analyzed by collecting primary and secondary data. The primary data were obtained to question by means of interviewing with the local farmers. Secondary data were obtained from the various departmental offices, addressing on soil, landing agriculture and intent sources.

Several field trips to Thanlyin Township. Gathering and referring to the books and relevant facts from library of university of Yangon and library of Geography Department and East Yangon University of Thanlyin. Some of the data, like maps, are modified and created from satellite images downloaded through the internet.

Findings and Discussion

Soil Types in the Study Area

Soil in Thanlyin Township can be grouped in seven types. They are as follows:

- (1) Meadow Alluvial Soils,
- (2) Light Brown Meadow Soils,
- (3) Brown Meadow Soils,
- (4) Meadow Gley Soils,
- (5) Meadow Gley Saline Soils,
- (6) Meadow Gley Swmapy Soils and
- (7) Lateritic Soils.

Meadow Alluvial Soils (*Fluvie Gleysol*)

Eighteen samples from Winkhani, Pharku (West), Laharyet, Nyaunglaypin, Kalawe and Pharku village tracts are taken and tested in the laboratory.

A soil that composed mainly of silt in its texture is called alluvial soil (*Fluvisol*). Such soils are found along the bank of rivers and creeks of Thanlyin Township. The soil are rich in nutrients as they are newly deposited every year. They are important for agriculture, since they are easy to cultivate crops.

There are many different sub-types of meadow soils (*Gleysol*). Le land or paddy land is mostly found on the plain along river banks. This type of soil is the most suitable for cultivation of paddy. The colour of the soil is yellow brown.

Light Brown Meadow Soils (*Gleysol*)

Thirty samples of light brown meadow soils are collected from Pharku Village, Dayzat Village and Laharyet Village, and tested in the laboratory at Insein Township.

Colour of the soil is light brown. Lower layers of the soils are more humid than upper layers. Sample soils are slightly different in colour, humidity, pH, texture, laterite content and iron accumulation.



Figure 1.1 Location of Yangon Region in Myanmar
Source: Myanmar Survey Department, Yangon

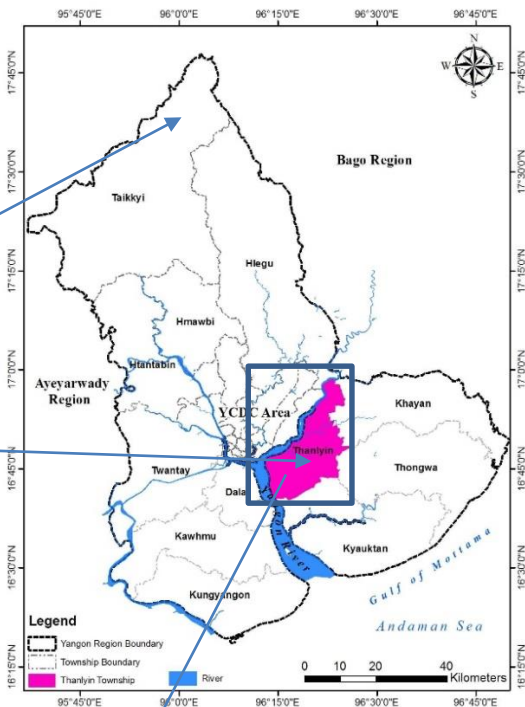


Figure 1.2 Location of Thanlyin Township in Yangon Region
Source: Myanmar Survey Department, Yangon

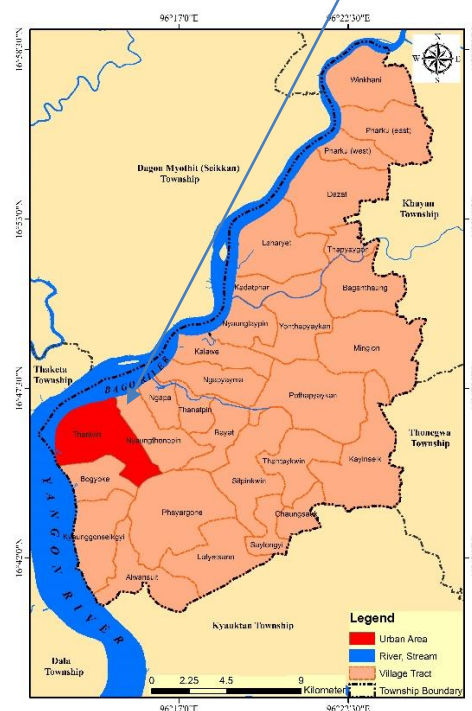


Figure 1.3 Location of Thanlyin Town and Village Tracts in Thanlyin Township
Source: Myanmar Survey Department, Yangon

Brown Meadow Soils (*Gleysol*)

Forty samples from Kalawe, Ngapyayma, Ngapa, Thaanutpin, Bayet, Nyaungthonepin, Sitpinkwin, and Letywtsan village tracts are collected and tested in the laboratory. Colour of the soil is brown.

Meadow Gley Soils (*Gleysol*)

Thirty-two samples from Nyaunglaypin, Thapyaykon, Bagantaung, Yonethapyaykan, Mingalon, Bothapyaykan, Thahtaykwin, Chaungsauk and Saylonegyi Village tracts are collected and tested in the laboratory.

The soils have dull brown colour and crack can be found when dry. Humidity of the soil is moist and solidity is hard. Structure of the soil is sub-angular blocky type. Lower layer wetter than upper layers. Those meadow gley soils can be sub-classified depending on their colour, humidity, pH, structure, texture, laterite content and iron variations. This type of soil is durable without any change.

Meadow Gley Saline Soils (*Gley Gleysol*)

Twenty-eight samples from Thanlyin urban area, Bogyoke, Kyaungkoneseikgyi and Alwansuit village tracts are collected and tested in the laboratory.

Meadow gley saline soils have beige colour. Permeability of the soil is good and thus lower layers are wetter than upper layers. They form on tidal affected location and commonly found in areas flooded by tide salt water especially coastal low lands.

Meadow Gley Swampy Soils (*Gley Gleysol*)

Eight samples of meadow gley soils from Nyaunglaypin and Yonethapyaykan village tracts are taken and tested in the laboratory. Meadow gley swampy soils have bluish grey colour.

Lateritic Soils (*Plinthic Ferrasol*)

Sixteen samples from Phayargone and Nyaungthonepin village tracts are taken and tested in the laboratory.

Upper layers of the soils have yellow or reddish colour and tiny and hard iron concentration can be found. Lateritic soils are found at near surface, and sometimes at some depth. They can occur in vadose zone of groundwater. Their visible feature is colour as yellow, brownish yellow or reddish brown.

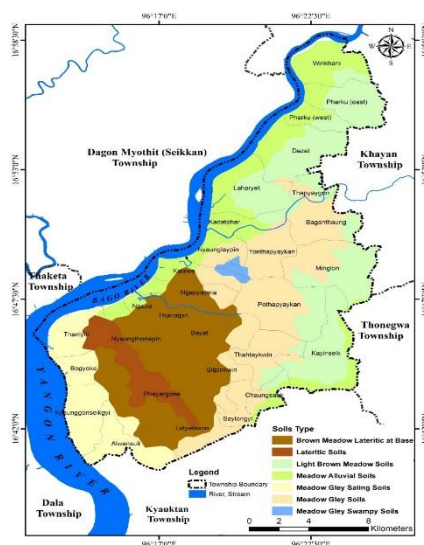


Figure 1. Distribution of Soil Types of Thanlyin Township
Source: Land Use Division, Agriculture Service, Yangon

Processes of Soil Degradation in Thanlyin Township

Soil degradation is caused by natural process and human activities. It is being exacerbated by the adverse impacts of climate change. Among the causes of soil degradation, some are population growth, indirectly caused by that force to expansion of agriculture to forests and marginal land. (Aklilv,2006)



Meadow Alluvial Soils
Winkhani Village (25/5/2018)



Light Brown Meadow Soils
Dayzat Village (25/5/2018)



Brown Meadow Lateritic Soils
Bayet Village (25/5/2018)



Meadow Gley Soils
Bothapyaykan Village (25/5/2018)



Meadow Gley Saline Soils
Bogyoke Village (25/5/2018)



Meadow Gley Swampy Soils
Yonethapyaykan Village (25/5/2018)



Lateritic Soils
Phayargone Village (25/5/2018)
Plate- Soil Types in Thanlyin Township

Table 1. Physical and Chemical Properties of Soils in the Study Area.

Sr. No	Soil Symbol	Mapping	Layer	Soil Depth	Soil PH	OC%	Humus%	Texture	CEC meq/100g	Total N%	Available Nutrient P	K ₂ O	EC Soil Water 1.5
1	Meadow Alluvial Soils,	1	A/P A/B	0"-8" 8"-25"	5.50-6.67 Moderately Acid Slightly Acid	1.5 Low	2.69	Sicl Sic	14.46 Medium	0.29 Medium	5.86 Low	14.44 Medium	-
2	Light Brown Meadow Soils	2D	A/P A	0"-9" 9"-25"	5.59-6.74 Moderately Acid Near Neutral	1.81 Low	3.13	Sic Sic	14.95 Medium	0.15 Low	4.54 Low	19.58 Medium	(EC) 0.48 Medium
3	Brown Meadow Soils	2E	A/P A/B	0"-6" 6"-8"	4.71-6.58 Strongly Acid Slightly Acid	2.45 Medium	4.23	Sil Sil	15.93 Medium	0.20 Low	1.37 Low	37.50 High	-
4	Meadow Gley Soils	3	A/P A/B	0"-10" 10"-25"	5.62-5.72 Moderately Acid	2.19 Medium	3.77	Sicl Cl	20.11 Medium	0.16 Low	5.54 Low	30.88 High	0.44 Medium
5	Meadow Gley Saline Soils	3B	A/P A/B	0"-10" 10"-20"	5.90-6.75 Moderately Acid Near Neutral	1.56 Low	2.68	C Cl	19.64 Medium	0.15 Low	4.79 Low	26.71 High	1.58 High
6	Meadow Gley Swampy Soils	3C	A/P A/B	0"-8" 8"-20"	4.88-4.79 Strongly Acid	1.98 Low	3.14	Sicl Sicl	18.15 Medium	0.18 Low	1.94 Low	19.73 Medium	-
7	Lateritic Soils	5	A/P B/C	0"-8" 8"-25"	5.06-4.96 Strongly Acid	0.81 Very Low	1.40	Sicl Sic	10.08 Low	0.11 Low	0.11 Low	4.32 Low	-

Source: Land Division. Myanmar Aericulture Services. Yaneon

Deforestation happens when a forest is cleared to make way for agricultural or a new settlement. It can also happen gradually as a result of ongoing forest degradation as temperature rise due to climate change. In Thanlyin, the area on the left bank of Bago River, west of Yangon Thanlyin Bridge (1) was once densely covered with tidal forest and swamp vegetation.

The causes of land degradation can be divided into natural hazards, direct causes, and underlying causes. Natural hazards are the conditions of the physical environment, for example, slopes as a hazard for water erosion. Agricultural depletion of soil nutrients through poor farming practices.

Soil degradation can result from overgrazing. Herd of cows are major animals that causes overgrazing. Overgrazing reduces and removes soils cover, and thus leads to soil erosion.

Temperature range is low, because the location of Thanlyin Township is close to the sea. The change of temperature is also little impact on the soil. After harvested crops when there is no land cover the soils is liable to crack in hot summer.

Soil degradation is the most serious environmental problem affecting the agriculture of Thanlyin Township. Physical soil degradation within the category of physical degradation, three types is identified. (1) Soil erosion

(2) Loss of Soil Structure

(3) Soil Compaction and Soil Subsidence

Soil erosion in Thanlyin Township begins with impact of raindrop. Clay particles are thrown and carries into the flow. Such rill erosion occurs on the slope without vegetation. Fine texture is more eroded. If there is plant cover, the erosion is less.

Erosion by rain water can be found on meadow alluvial soils in Winkhani, Pharku (west), Kadatphar, Laharyet, Nyaunglaypin, Kalawe, Ngapa, and Nyaungthonepin Villages on the bank of Bago River, and Kayinseik and Chaungsauk village on the banks of the Hmaw-wan Chaunh. Other areas affected by rain water are on lateritic Soils of Thanlyin urban area, Phayargone and Letyetsan village.

Soil structure is important for water and movement in a soil, nutrient availability for plant, root growth, and activity of microorganism in the soil. Soil structure can be destroyed by over-tilling when the soil is very wet.

Medium depths of soil can be found in Winkhani, Pharku (west), Dayzat, Laharyet, Thapyaygon, Kadatphar, Bagataung, Nyaunglaypin, Pothapyaykan, Yonethapyaykan, Mingalon, Ngapyayma, Thahtaykwin, Kayinseik, Chaungsauk, Saylongyi, Alwansuit, Kyaunggoneseikgyi, Thanlyin urban area, Bogyoke and Nyaungthonepin villages.

Thin depths of soil are found in Ngapa, Thanatpin, Bayat, Sipinkwin, Phayargone, Nyaungthonepin and Letyetsan villages.

Soil compaction is found in Pharyargone village, Bayet Village and Pothapyaykan Village of Thanlyin Township. Soil compaction also happens for its texture. Soil compaction is common is laterite soil. Such laterite soil is found in Phayargone villages. Soil in Bayat Village is hard when it is dug. Soils in other villages are not hard, as moisture is evenly distributed in all layers.

Soil subsidence is found in Winkhani, Pharku (west), Nyaungthonepin, Kakawe, Ngapa, Thanatpin, Ngapyayma, Thapyaygon, Bagataung, Bogyoke, Alwansuit,

Kyaunggoneseikgyi villages and urban area. However, extent of subsidence is small.

Chemical soil degradation is the loss of organic matter, decline in soil fertility, adverse changes in salinity, acidity or alkalinity, and the effects of toxic chemical pollutants. Chemical soil degradation includes salinization, loss of nutrient and organic matter and soil pollution.

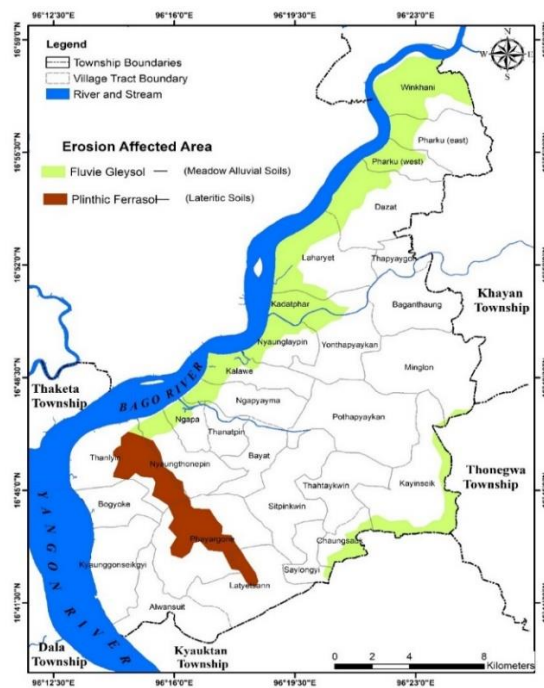


Figure 2. Erosion Affected Area in the Study Area

Source: Land Use Division, Myanmar Agriculture and Irrigation, Yangon

Soil conservation is the preventing of soil loss from erosion or reduced fertility causes by over usage, acidification, salinization, or other chemical soil contamination.

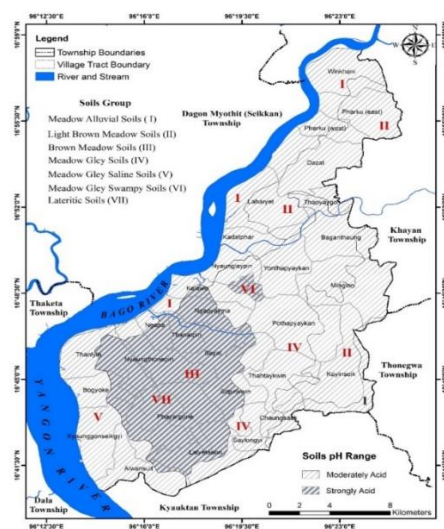


Figure 4. Distribution of Soil Salinization in Thanlyin Township.

Source: Base on Table.

Conclusion

Thanlyin Township is situated in the Southern Yangon District. It is one of the forty-five townships of Yangon Region. It is located on the left bank of Bago River. The total area of Thanlyin Township is 383.3 sq.km. Thanlyin Township can be divided into two parts i.e. urban area (Thanlyin Town) and rural area. The major rivers are the Bago River and Yangon River. As Thanlyin Township experiences humid tropical climate, the average mean temperature is 27.18°C (80.92°F) and the average annual rainfall is 2869.82mm. Most of the rock units found in Thanlyin Township Irrawaddy Group formed in Pliocene.

Variations in the supply of soil water depend directly upon the ratio of precipitation to evapotranspiration. Seven types of soil can be found in the study area. They are as follows;

- (1) Meadow Alluvial Soils,
- (2) Light Brown Meadow Soils,
- (3) Brown Meadow Soils,
- (4) Meadow Gley Soils,
- (5) Meadow Gley Saline Soils,
- (6) Meadow Gley Swampy Soils and
- (7) Lateritic Soils.

Soil degradation is caused by natural processes and human activities. It is being exacerbated by the adverse impacts of climate changes. Poor and inappropriate land management is the main causes of physical and chemical degradation of cultivation land.

Soil conservation is the preventing of soil loss from erosion or reduced fertility caused by over usage, acidification, salinization, or other chemical soil and contamination. Certain conservation measures can reduce soil erosion. Soil / land management practices such as tillage and cropping practices, directly affect the overall soil erosion problem and solution on a farm. When crop rotations or changing tillage on a field, a combination of measures might be necessary. For example, crop rotation, agro forestry, intercropping or double cropping may be considered.

Acknowledgements

First and foremost, I would like to express my warm thanks to Dr. Nay Win Oo, Rector, East Yangon University, and Dr. Aye Aye Ko, Dr. Wah Wah Lwin and Dr. Thida Aung Pro-Rectors, East Yangon University. Dr. Nyein Nyein Win Professor and Head of Department, Department of Geography, East Yangon University, for their permission to do this Research Journal and their suggestions and encouragements in the preparation of the research.

I would like to express my thanks to U Nyi Nyi Aung, Assistance Lecturer, Department of Geography, Ministry of Border Affairs Department of Education and Training Nationalities Youth Resources Development Degree College (Yangon) for his patient help in Map drawing.

Many special thanks are due to the members of Government Department, Land Use Division, Myanmar Agriculture Services and persons who response to the questionnaires and interview. Lastly, I would like to express my heartfelt thanks to my parents, all my teachers and my friends for their great understanding, supports and encouragements.

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GEOGRAPHICAL STUDY ON DEMOGRAPHY OF KHAYAN TOWNSHIP

Khin Khin Win*

Abstract

This research presents a study on demography of Khayan Township from geographical point of view. Khayan Township is situated in the Southern District of Yangon Region. Khayan Township comprises 13 Wards and 53 Village Tracts. The main aim of this study is to identify urban and rural population in Khayan Townshp. To obtain the relevant data, structured interview survey method is used. It is analysed by population pyramid is concerned with population growth, distribution, density, age and sex composition, families and household, birth and death rate, occupation, education and health care. Moreover, the topographic maps and GIS techniques are utilized to analyze the demography features of the study area.

Key words: demography, population pyramid, dead rate, birth rate, life expectancy, population density

Introduction

Khayan Township is situated in the Southern District of Yangon Region. Khayan Township comprises 13 Wards and 53 Village Tracts. Population is one of the essential elements of a State. The size of population exerts profound influence on social, political and economic development of a specific area. Demographic characteristics reflect the development level of the social and economic well-being of a State. Myanmar is rich in natural resources and has sufficient manpower to exploit the resources. The distribution of resources is uneven, so does the distribution population. Khayan Township is rich in agricultural land and aquatic resources. The population of Khayan Township is estimated at 166,395 in 2017. In order to know the temporal and present demographic characteristics of the region, the title 'Geographical Study on Demography of Khayan Township' is chosen to conduct a research work.

The aim of the study

The aim of the study is to evaluate the demography of Khayan Townsship.

The objective of the study

- (i) to analyze the basic demographic characteristics of the population,
- (ii) to assess the social factors of the population, and
- (iii) to highlight the future trends of the structure of the population.

Sources of Data and Methodology

In this research work, data are first collected from departments concerned and some are obtained by detail inquiry and survey. Then they are described and analyzed. The unique facts are explained on the cause and effect basic. Comparisons are made where it is deemed necessary. Maps and diagrams are presented for illustrations.

In preparing this thesis, the relevant book, thesis and departmental publications are read for references internet surfing has been done for wider. Dates are mostly acquired from Immigration and Man Power Departments of Khayan Township.

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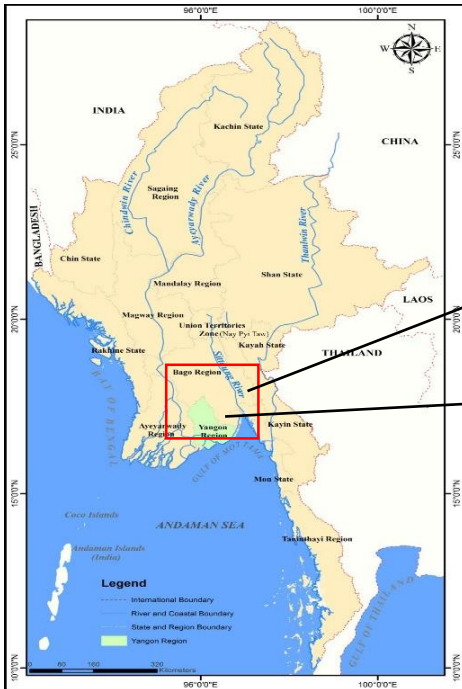


Figure 1 Location of Yangon Region

Source: Land Survey and Land Record Department, Yangon Region

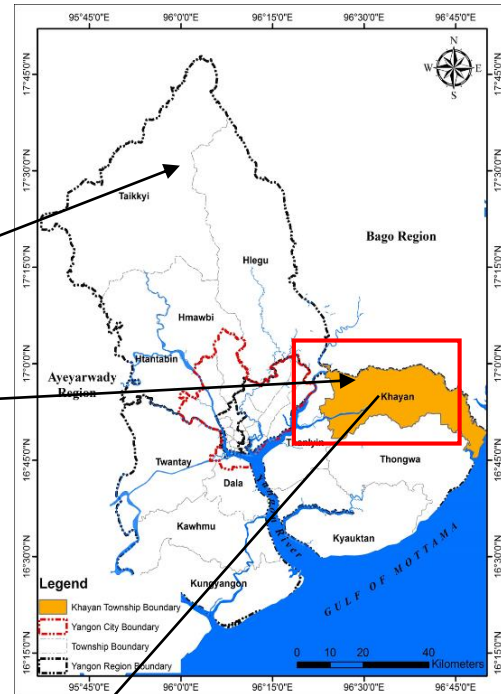


Figure 2 Location of Khayan Township in Yangon Region

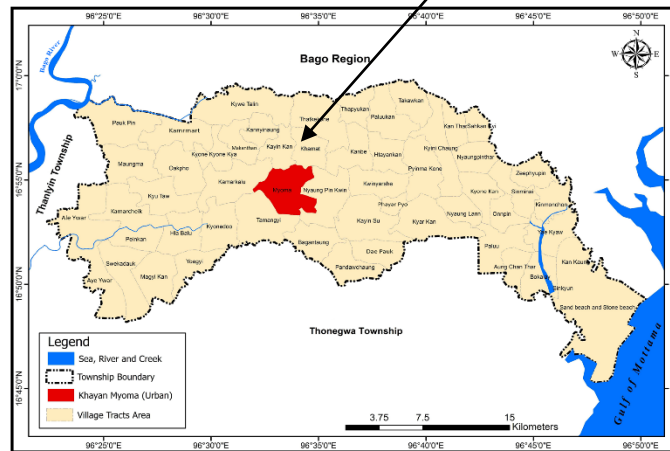


Figure 3 Location of Khayan Township

Source: Land Survey and Land Record Department, Yangon Region

Physical Background

Khayan Township is located in the southern part of Yangon Region. It lies between North Latitudes $16^{\circ} 22'$ and $16^{\circ} 49'$ and East Longitudes $96^{\circ} 22'$ and $96^{\circ} 51'$. The total area of township is 151,518 acres (613.17 square kilometres). Khayan Township comprises 13 Wards and 53 Village Tracts.

Khayan Township has an elongated shape with wider western and middle parts forming main body with narrow protrusion towards southeast. Khayan Township is bounded on the east by the Gulf of Mottama, in the west by Thanlyin Township, in the south by Thonegwa Township and in the north by Kawa Township.

Khayan Township is situated between the Ayeyarwaddy and Sittaung Deltaic Regions. The village on the east of Khayan, like Kanthar, Sakhangyi, Nyaung Pin Thar, Kyone Kan, Zephyupin, Sinminai, Onnpin, Kinmonchon, Yae Kyaw, Kan Kaung, Aung Chan Thar, Bokalay and Sinkyun village tracts are closed to the Gulf of Mottama and have a height of below 3.408 metre (11 feet) above mean sea-level.

The township is drained by many small creeks, most of them are seasonal, flowing only in rainy season. They are major important for agriculture and transportation. As the study area is a part of the deltaic region in lower Myanmar, it experiences hot and wet climate namely Tropical Monsoon type of climate.

Historical Background

Till the time when the Second British-Myanmar War broke out in 1852 AD, the area of present location of Khayan was merely a shallow sea shore and inundated silt flat covered with wild tall grass, and hence there was no settlement. Later on, fertile soil and flat surface of the area and easy access to Bago, attracted human settlement. Pioneer settlers were Mons. Then, in 1856 AD a hamlet emerged at that placed and called it in Mon Language 'KaRone', which means 'young alluvial bank' or 'flowing stream'. As time passed, Mon name 'Ka Rone' has gradually changed 'Kha Rone', and Kha Ran, then Khayan.

Findings and Discussion

Population Growth

In 1910, Khayan village was promoted to town level and officially became township heads seated site officially. Thus, Khayan had direct access to Capital City, Yangon through waterway. Consequently, as transportation developed, the economy of Khayan grew and Khayan attracted more population and more economic activities. Khayan was included in Hantharwady District Administration. The population statistic for each year has been published occasionally as estimated population.

Table 1 Population Growth of Khayan Township (1973-2017)

No.	Year	Male	Female	Total	Net growth	Growth Rate
1.	1973	50,113	54,510	104,423	-	-
2.	1983	64,702	66,875	131,577	27,154	2.6
3.	1993	66,204	69,783	135,987	4,410	0.33
4.	2003	72,354	74,292	146,646	10,659	0.78
5.	2007	73,820	77,026	150,846	4,200	0.71
6.	2014	75,510	82,509	158,019	1,529	0.97
7.	2017	80,893	85,502	166,395	8,376	1.76

Source: Man Power and National Registration Department, Khayan Township

Large labour demand in construction site of Yangon-Thanlyin Birdge around the year 1990 and construction sites of Yangon and Bago in early 1990s attracted young and adult people of the study area. With emigration of married pairs, the number of births also declined. As a result, average annual growth rate has declined from 2.6 percent in 1983 to 0.33 percent in 1993. The population in urban area and lowering in rural area reflecting rural to urban migration to find job opportunity for poor rural people and settle in the town for wealthy rural people.

Population Distribution

Population of study area is unevenly distributed over 13 wards of urban Khayan and 53 village tracts of vast rural area of Khayan Township. Since agriculture is major economic activity of the township, most of the population is found in rural where the land is flat and fertile, and transportation is feasible for agricultural products.

Of the total population of 166,395 persons in 2017, 35,405 persons were in urban area and 130,990 persons were in rural area. Thus, 21.28 percent of total population was urban and 78.72 percent was rural. The most highly populated ward of Khayan was Ward No. (3) with a population of 5,312 persons in 2017. The ward is located between Thanlyin-Thonegwa-Bago Highway Road and Pagoda Road that leads to Myo Ma Market, Township Hospital and Government Office of the township. The least populated wards were Ward No. (4) with only 774 persons and Kon-Moe-Dain Ward with 1,741 persons. Narrowness of the Ward No. (4) is the cause of its least number of populations. Kon-Moe-Dain Ward is a newly extended ward, infrastructure of that ward is a still under implementation for infrastructure, and not yet finished, thus the ward is less attractive for people to settle in.

All the areas around Khayan is rural land where 130,990 persons of rural people lived. The highest number of population is found in Nyaung Pin Kwin village tract with 5,605 persons, as the village tract is located adjacent to urban Khayan.

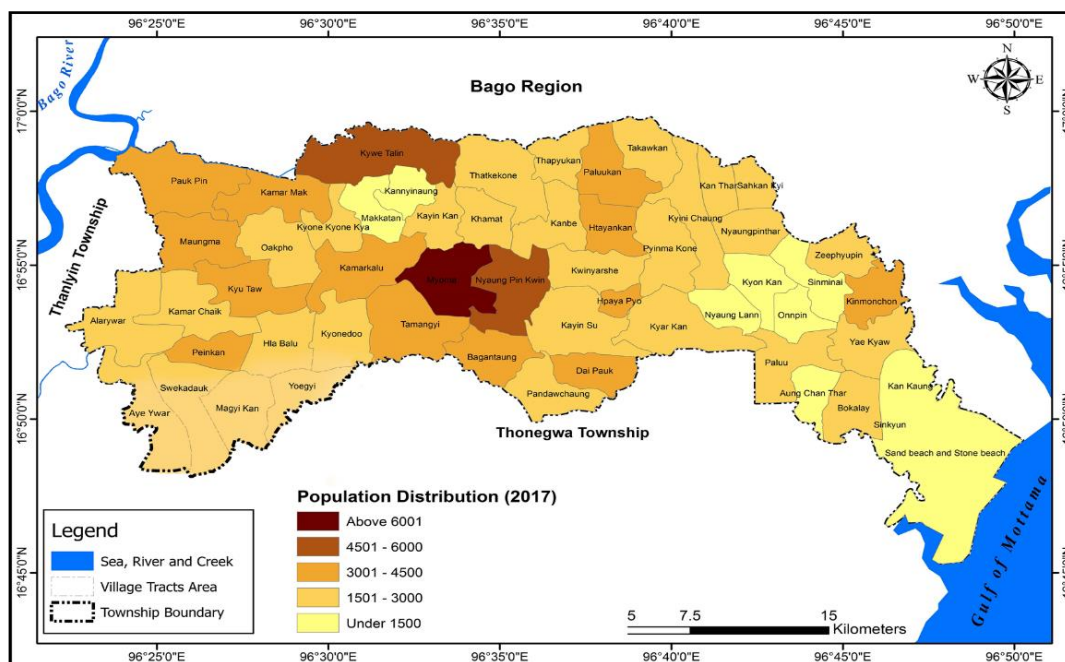


Figure 4 Population Distribution of Khayan Township (2017)

Source: General Administrative Office, Khayan Township

Population Density

The total population of the township was 166,395 persons in 2017 and total area of Khayan Township is 613.17 square kilometre. Khayan Township is one of fairly populated townships of Yangon Region. The causes of fairly dense population are (1) the land is a part of delta region with fertile soils and good agricultural land, and (2) locating on Thanlyin-Thonegwa-Bago Highway and having both water and land transportations to Yangon and Bago. Population density of the study area is increasing because population of the township is ever growing, despite the area being constant.

In 2017, the total population of urban area of Khayan Township was 35,405, and total area of urban Khayan (so-called Myoma) was 18.09 square kilometres. Thus overall population density of urban area was 1,957 persons in 2017. Being a capital of township, Khayan possesses good communication, trading center, industrial activities and government administrative offices in the town. The highest population densities were found in Ward No (4) and Ward No (6) with 9,675 persons and 9,643 persons per square kilometre respectively.

Table 2 Population Density of Khayan Township (1973-2017)

Year	Township Area (sq. kilometre)	Total Population	Density (Persons per square kilometre)
1973	613.17	104,423	170
1983	613.17	131,577	214
1993	613.17	135,987	222
2003	613.17	146,646	239
2007	613.17	150,846	246
2014	613.17	158,019	258
2017	613.17	166,395	271

Source: Man Power and National Registration Department, Khayan Township

Total area of rural land of the study area is 595.08 square kilometre and total rural population was 130,990 in 2017. Thus, overall rural population density was 220 persons per square kilometre. Among all 53 village tracts, 26 village tracts were above it and 27 village tracts were below it. Since majority of rural area is farmland and villages are widely spaced like scattered spots over vast area, overall population density is normally low.

Nyaung Lann is relatively low area and hence poor drainage hinders the feasibility of agricultural activity and human settlement. Rural area in eastern portion of Khayan Township is more densely populated than those in western portion despite all the least dense village tracts are located in the far east and southeast.

Age and Gender Composition

Age compositions may differ spatially and temporally because of different fertility rates. A population with persistently high fertility has a large proportion of children and a small proportion of aged persons. A population in which fertility has been low for recent years has a small proportion of children and a larger proportion of aged persons. The highest number of population is found in young age groups. In (10-14) age groups, there is largest number of population with 16,510 persons or 9.92 percent of total. It can be found that number of people in the age group of

65 years and above. The major causes for their long-lived lives are living in clean environment, receiving better health care and becoming wealthier.

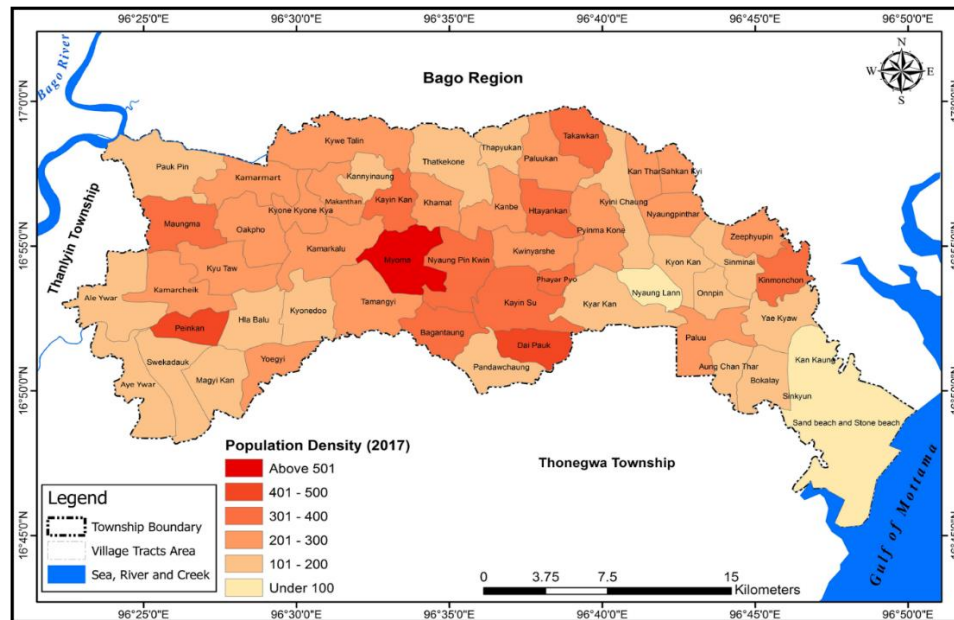


Figure 5 Population Density of Khayan Township (2017)

Source: General Administrative Office, Khayan Township

Families and Households

Household is a unit which includes all persons living under one roof or occupying a separate house having a separate cooking facility. When the members of a household are related by blood, marriage or adoption, it can be called a family. In 2017, total population is 166,395 and average family size becomes 4.2 persons. Thus, the family size of the township is lower than average family size of Myanmar, which is 4.4 persons.

Average family member is highest in Paluu Village Tract with 5 persons, the second highest is in Kyone Kyone Kya Village Tracts with 4.8 persons and the third most are for Nyaung Lann, Sakhangyi and Kan Thar Village Tracts with 4.7 persons. The lowest number of family member is in Kamarcheik Village Tract with 3.4 persons.

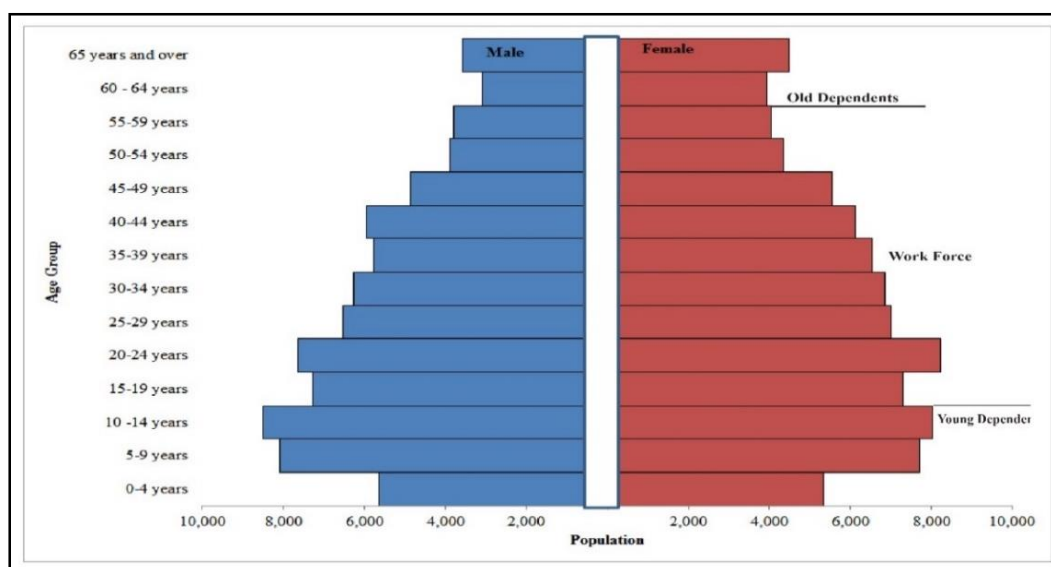
Birth Rate and Death Rate

Birth rate is the demographic measure of the rate at which children are born. The rate is stated as the number of births that occur each year per thousand people in a population. Crude birth rate of 2017 has declined in recent years (16.6 for 2014 15.6 for 2017). Such declined is the result of two changes – one is to increase in to total population and the other is decrease in number of live birth.

Table 3 Age Distribution of Population in Khayan Township (2017)

No	Age Group	Total	(%)	Male	(%)	Female	(%)
1	0-4	10990	6.6	5,651	7.0	5,339	6.2
2	5-9	15,806	9.5	8,083	10.0	7,723	9.0
3	10-14	16,510	9.9	8,497	10.5	8,013	9.4
4	15-19	14,596	8.8	7,292	9.0	7,304	8.5
5	20-24	15,892	9.6	7,648	9.4	8,244	9.6
6	25-29	13,520	8.1	6,519	8.1	7,001	8.2
7	30-34	13,121	7.9	6,272	7.7	6,849	8.0
8	35-39	12,304	7.4	5,766	7.1	6,538	7.7
9	40-44	12,060	7.2	5,948	7.4	6,112	7.2
10	45-49	10,425	6.3	4,862	6.0	5,563	6.5
11	50-54	8,254	5.0	3,906	4.8	4,348	5.1
12	55-59	7,844	4.7	3,792	4.7	4,052	4.8
13	60-64	7,019	4.2	3,086	3.8	3,933	4.6
14	65+	8,054	4.8	3,571	4.4	4,483	5.2
	Total	166,395	100	80,893	100	85,502	100

Source: Man Power and National Registration Department, Khayan Township

**Figure 6 Population Pyramid of Khayan Township (2017)**

Source: Based on Table (3)

Death rate is a demographic measure of the number of deaths per year in a particular population, scaled to the size of that population. The mortality rate is typically expressed in number

of deaths per 1000 people per year. It is found that the child death rate of age under 1 year for study area is significantly low when compared to that of South Yangon District which had a death rate of children age under 1 year 56 persons per thousand live births in 2014. 'Maternal death' is defined by the World Health Organization (WHO) as the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration of the pregnancy.

Life expectancy in Myanmar was 64.7 years in 2014, with 70.8 years for female and 60.5 years for males. Life expectancy of people in Yangon Region was 65.5 years, life expectancy of the people in Khayan Township was 65.2 years, and it was comparable to the region. In 2017, life expectancy of people in the study area became lower to 62.5 years. (<https://www.en.m.Wikipedia.Org>)

Marital Status

Marital status is the legally defined marital state of individuals. Each individual falls in one type of the following: single, married, widowed, divorced and renounced. Overall, marital status of a population is significant in consideration of future population growth, age composition and potential workforce.

Occupation

Occupation structure of Khayan Township is analyzed based on the 2017 population data. Major occupations found in the study area are farming, fishery livestock breeding, trade and commerce, service, industry, fishery, staff of government departments and staff of private business and organization. Farming is an important activity of Khayan Township due to possessing vast fertile land. Paddy lands overwhelm most of the area and paddy farming is major occupation of the township. In 2017, there are 35,391 persons engaged in farming and it accounts for 27.9 percent of total workforce of the township.

Education

Since the time of Myanmar Kings, education has been centered on monasteries. The monasteries have taught not only literacy but also essential professions like traditional medicine, astrology and art of self-defense. Therefore, most of males were more educated than females in the past. After independence, with the establishment of primary schools in rural areas, literacy ratio has become higher ever than before.

Health Care

There are three hospitals of circle level, one in each of Kamarmart, Kyinichaung, and Peinkan village tracts. Kamarmart village tract, eight sub-centres of rural health care are established in that village tract. One station-medical-officer, three nurses, four nurse-midwives, one dispensing staff and two cleaners are assigned in circle level hospital of Kamarmart village tract. In addition to the hospital, eight sub-centres of rural health care are established in that village tract. There is also a maternity and childcare centre attached to rural health care centre.

Khayan Township is located in southeastern portion of Yangon Region comprising thirteen urban wards and fifty-three village tracts. Flat plain is the most distinctive topographic feature. Khayan Chaung is major drainage and there are numerous streams across the area.

Table 4 Birth Rate and Death Rate of Khayan Township (2014-2017)

Year	Total Pop	Total Births	Live-birth		Death Rate		Death-birth		Death Rate (under 1 year)		Death Rate (under 5 years)		Maternal Death Rate	
			N	C-B-R	N	C-D-R	N	D-B-R	N	D-R per 1000	N	D-R per 1000	N	D-R per100,000
2014	158,019	2,666	2,632	16.6	955	6.04	34	12.9	62	23.5	72	27.0	3	113
2015	166,052	2,612	2,586	15.6	864	5.2	26	10.1	64	24.3	63	24.0	2	77
2016	166,260	2,638	2,623	15.8	928	5.9	15	5.7	52	19.8	54	20.5	1	38
2017	166,395	2,622	2,593	15.6	985	5.9	29	11.2	43	16.3	60	22.8	3	114

Source: Township Public Hospital, Khayan Township

Notes:

N - Number of Population
C.B.R - Crude Birth Rate
D.B.R - Death Birth Rate
D.R - Death Rate

Table 5 Marital Status of Mature Population of Khayan Township (2017)

Marital Status	Total	Percent	Male	Percent	Female	Percent
Single	51,749	42.8	24,466	42.6	27,283	43.1
Married	56,460	46.7	27,075	46.8	29,385	46.5
Widowed	10,720	7.1	5,089	7.1	5,631	7.0
Divorced	2,936	2.4	1,390	2.4	1,546	2.4
Renounced	1,224	1.0	642	1.1	582	1.0
Township Total	123,089	100	58,662	100	64,427	100

Source: Man Power and National Registration Department, Khayan Township

Table 6 Percentage Distribution of Population 5 years of age and above by Literate and Illiterate (2017)

Literate/Illiterate	Total	Percent	Male	Percent	Female	Percent
Literate	146,216	94.1	69,802	93.6	76,414	94.5
Illiterate	9,189	5.9	4,772	6.4	4,417	5.5
Township	155,405	100	74,574	100	80,831	100

Source: General Administrative Office, Khayan Township

Total population of Khayan Township was 104,423 in 1973 and 166,395 in 2017. Average annual growth rate during 1973 and 2017 is 1.01 percent. Population is unevenly distributed over the township. Most of the population (78.72 %) is distributed in 53 village tracts and some 21.28 % are in Khayan urban area



Plate 1 Township Hospital of Khayan
(25/7/2018)

Source: Compiled by Researcher



Plate 2 A Circle level Hospital in Peinkan
Modal Village (7/8/2018)

Source: Compiled by Researcher

In 2017, average population density of overall township is 271 persons per square kilometre. Population density of urban area is 1,957 persons per square kilometre. Average population density of 53 village tracts is 220 persons per square kilometre. More number of populations is found in young age group. Average family size for the whole township is 4.2 persons and it is fewer than family size of Myanmar. There is a total of 2,593 live-births showing a crude birth rate of 15.6 per thousand populations in 2017. There is a total death of 985 persons in 2017, death rate is 5.9 persons per thousand. The death rates are significantly lower than that of Yangon Region and the Southern Yangon District. Maternal death rate is 114 persons per 100,000 mothers. Life expectancy of people in the study area is only 62.5 years.

Racially, majority of the population is Bamar comprising 98.89 percent of total population. Major occupations in the study area are farming, fishery, livestock breeding, trade and commerce, various service activities, industry, staff of government departments and private owned business, miscellaneous odd jobs and unclassified occupations. The literacy ratio of age 5 years and above is 76.6 percent. There are one township level public hospital, three circle level hospital, seven rural health care centres and forty-two sub-rural health care centres.

There is no distinct problem found in the current population of Khayan Township. The number of population and resources in the study area can be assumed balance. However, it is better to lower the number of dependents to be more effective in resource exploitation. On the other hand, high elder dependency ratio is an indicator of better health care and it cannot be controlled to be lessening.

Although present young dependency ratio cannot be controlled to be lower, it can be managed not to become higher in near future. The first factor is to promote education in rural area. In the rural area, more young females get married in early adolescent stage before completing their education. Such early marriages are also consequence of low education status. If they are more educated and have wider knowledge and more experiences. Family planning in marriage couple has impacts on dependency ratio and in turn on economy area.

This is research work on the demography of Khayan Township conducted essentially from the geographical point of view. If such other field of studies as Agriculture, Construction Technology, Sociology, Hydrology, Geology and Economic separately or in coordination show concern about the physical conditions and social and economic well-being of the local populace of the township, more effective and practicable suggestions may come out for further prosperity of the township.

Conclusion

Khayan Township is one of forty-five Townships of Yangon Region including Southern District. The township is located between north latitudes 16° 22' and 16° 44' and between east longitudes 96° 22' and 96° 51'. It is 75.639 km (47 miles) away from Yangon and 22.531 km (14 miles) from Bago. The study area lies between Ayeyarwady Delta and Sittaung Delta. It experiences a hot and wet climate, which is tropical monsoon (Am) type. Four-fifth of the land of the township is covered with meadow alluvial soil that is suitable for paddy farming and other agricultural activities.

Total population of the study area is 166,395 persons in 2017. The population is unevenly distributed. In 2017, average population density for entire township is 220 persons per square kilometre. The importance of some major village tracts and urban wards are related to good communication, availability of fresh water, electricity, and sanitation services. Average birth rate of the study area is 15.6 persons per thousand populations and average death rate is 5.9 persons

per thousand populations. Both birth rate and death rate have declined in recent years. The decline in death rate is a result of improved health care and hygiene education in the township.

With regard to marital status, 42.8 percent of townships total population is singles, 40.7 percent is married, 7 percent is widowed and 3.4 percent is divorced and renounced. Major occupations of the majority of the population are paddy farming and animal breeding. A 50-bed township public hospital is in Khayan urban area and three 16-bed hospitals seven health care centres and 42 sub-centres are serving in rural areas. Therefore, it is needed to appoint more health care staff, particularly doctors and nurses, to provide more effective health care service for the public. Indeed, the study area provides valuable outcomes by surveying and research. The changing pattern and the quality of life will be improved.

Acknowledgements

First and foremost, I would like to express my warm thanks to Dr. Nay Win Oo, Rector, East Yangon University, Dr Aye Aye Ko, Dr Wah Wah Lwin, Dr Thidar Aung, Pro- Rectors of East Yangon University, Dr Nyein Nyein Win Professor and Head of Department, Department of Geography, East Yangon University, for their permission to do this Research Journal and their suggestions and encouragements in the preparation of the research.

I would like to thank U Nyi Nyi Aung, Assistant Lecturer, Department of Geography, Ministry of Border Affairs Department of Education and Training Nationalities Youth Resources Development Degree Collage (Yangon) for his patient help in drawing maps. Many Special thanks due to several officials from Government Departments and Offices for providing data for my research work. Finally, I would like to express my heartfelt thanks to my parents, all my teachers and my friends for their great understanding, supports and encouragements.

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AGRICULTURAL LIFE AND LIFE-STYLE DURING THE BAGAN PERIOD (A.D.1100-1250)

Ko Ko Toe Lwin Thaw*

Abstract

The agricultural sector supplies staple food for Bagan people and is essential for commerce in local and abroad. The farming life and life-style of Bagan period is found in narrative stories illustrated on the walls of Bagan temples and mentioned in their captions. The agricultural life can be also traced in the evidences of inscriptions. The rural life-styles of common people including *asañ*, freemen including rich men and *klwan*, slaves who are ordinary workers as well as their implements are seen in the scenes of *Mahā Buddhavam* and 550 *Jātakas* of most Bagan temples. The agricultural related professionals are merchants who mainly used carts and boats. Their lives and life-styles are also illustrated in these mural narrative stories. These Buddhist stories reflect the socio-economic life and life-style of old Myanmar people during the Bagan period.

Key Words: Agriculture, *Jātaka* Story, Bagan Life-style, Rich Men, Merchant, Implement

Introduction

The most important sector of socio-economic life of Bagan is the agriculture and land related business. In fact, the village communal life and life-style is constituted with various agricultural occupations and land related professions based on rural community of provincial areas (*karuin* and *tuik*). The evidences of agricultural lives and life-styles are found in inscriptions and *jātaka* legends and their figures illustrated as the narrative stories in the murals on the walls of Bagan temples. Dr. Than Tun classified the professionals in Bagan period into five categories based on the list of slaves mentioned in the inscriptions. They are agriculturalists, food suppliers, craftsmen, musicians and dancers and miscellaneous professionals¹ Out of them, the agriculturalists are the most basic village communal lives of Bagan. Many scholars did not use mural *jātaka* stories including figures and their narrative captions and ink glosses to illustrate the social life of Bagan people. They did not manifest and illustrate the rural life of aristocrats and commoners who are regarded as the freemen. How village communal life and life-style of the common people would have existed in Bagan period will become a main question in the study.

The research study will specifically discuss village farming life and life-style of common people constituted with both freemen and slaves referring to the epigraphic and visual evidences especially based on *jātaka* mentioned notes. The way of life of commoners, free men called *asañ* can be traced in the list of witnesses for dedication mentioned in the inscriptions and Buddhist narrative stories i.e., *Mahā Buddhavam* and 550 *Jātakas* with mentioned notes. The kinds of farming implements used in Bagan period will be explicitly discussed according to the visual evidences of Mon type temple called Myinkaba Kubyauk-gyi (Monument No-1323) and Myanmar type temples, Wetkyi-in Kubyauk-gyi (Monument No-298). The former was built in A.D.1113 during the time of king Kyanzittha who used the Mon language for unification of Bagan kingdom. The donor of temple was Prince Rajakumar, son of Kyanzittha. The latter was probably built in the early 13th century during the reign of king Narapatisithu who widely used Myanmar language in Bagan kingdom.

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¹ Dr. Than Tun, "History of Buddhism in Burma, A.D. 1000-1300", Ph.D. Thesis Submitted to SOAS, Revised and Enlarged Edition, *Journal of Burma Research Society*, Vol. LXI, i& ii, Yangon, Burma Research Society, 1978, pp.158-162, (Hereafter cited as Dr. Than Tun, "History of Buddhism in Burma")

Agricultural Life and Life-style of Village Community of Bagan Period (A.D.1100-1250)

The staff of life of Bagan was paddy, *capā*²(*sro* in Mon) which is mentioned in the inscriptions and *jātaka* captions³. Other grains such as Panicle Millet (*chap*), Sorghum Millet (*proñ*) and Barley (*mūyaw*) were also important for village communal life. Rice, on the other hand and irrigated rice-fields (*lay* or *lai*), are mentioned thousands of times in the inscriptions. Shin Disapramuk at the end of the dynasty effectively stated the claims of rice in his interview with Khublai Khan in Peking. He knew that 20000 troops were on the march to Bagan and that owing to war cultivation had been suspended there for over a year. He argued not to send the Chinese army there because it was the time to cultivate for rice which was “the root of a country’s prosperity”.⁴ It is obviously noted that the cultivation of paddy is encouraged and esteemed by government since that time.

According to the inscriptions, the most manors of lands were possessed by aristocrats such as land lords called *bhumma*⁵, wealthy man called *sūthiy* or *sūkrway*, corn-merchant or rice-merchant? *hañ*⁶ or *capā kunsañ*⁷, caravan merchant _ *lhañ kun sañ*, leading land owner _ *khetarā*⁸ and land agent _ *pway krakri*⁹. They all are regarded as *sūkoñ* or *kumtham* meaning the gentry. The class mostly found in the inscriptions and narrative stories is the rich man called *sūkyway* because they frequently dedicated lands and slaves to the monasteries and pagodas. Their lives and life-styles are usually mentioned in inscriptions and depicted in Buddhist narrative stories as the visual evidences and visual images on the walls of Bagan temples.

² All old Myanmar words from the inscriptions are spelt in accordance with the rules of transliteration given in Appendix I and typed in Italic font. See in Appendix I

³ (a)The word, *capā kun sañ*, a rice-merchant is mentioned as a professional of Bodhisattva in the *jātaka* stories of JĀ.249, Sālaka and JĀ.365, Ahikundika illustrated in Myinkaba Kubyauk-gyi .

(b)See Figure 1

(c)G. H. Luce, Ba Shin, “Bagan Myinkaba Kubyauk-Gyi, Temple of Rājakumār (1113 A.D.) and the Old Mon Writing on its Walls”, *Bulletin of the Burma Historical Commission*, vol. II, Yangon, *Burma Historical Commission*, 1961, pp.331-362 (Hereafter cited as Luce, “Bagan Myinkaba Kubyauk-gyi”)

⁴ (a)Pl.271²³⁻²⁴, G.H. Luce, and Pe Maung Tin, *Inscriptions of Burma*, 5 Portfolios, Oxford, Oxford University Press, 1933- 57, there are 610 plates in these five portfolios. The first three Portfolios of these inscriptions belong to the Bagan period and some post- Bagan period. The document records in the Portfolio are referred to plates (pl.) with serial number. Some plates of fragments of a stone have same plate with number and serial alphabets. The lines are also used with numbers in upper character.

(b) G.H. Luce, “The Economic Life of the Early Burman”, *The Fiftieth Anniversary Publications No.2 , Selection of Articles from the Journal of Burma Research Society*, Yangon, Burma Research Society, 1960, p.328 (Hereafter cited as Luce “The Economic Life of the Early Burman”)

⁵ Pl.193²³⁻²⁴ mentions *chañ sukrī Bhumma Sū*, *Bhumma Siñkhā Himawan* and *Bhumma Sū sā rwāsac sukrī Nā Khat Rok Sañ* are the headmen of elephants who supervise mahout and the related elephant work.

⁶ JĀ-70 Kuddala *Jātaka* of Wetkyi-in Kubyauk-gyi mentions *hañ cuik sa sū* _ vegetable-gardener. Today the word *hañ-rwak* is applied as a modern glossary for vegetable.

⁷ The captions of *capā kunsañ* are revealed in JĀ-249.Sālaka and JĀ-365.Ahikundika of Wetkyi-in Kubyauk- gyi.

⁸ Pl.9b⁸ G.H. Luce and Pe Maung Tin, “Inscriptions of Burma”, (Transliteration and Translation of Pl.1 to 20 with notes), *BBHC*, III, Yangon, Myanmar Historical Commission, 1963, p.77

⁹ (a)*Pway kri*  or *pway krakri*  was the land inquiry agent of the province (*tuik*) assisting the headman of province (*tuik sukrī*)

(b)Luce “The Economic Life of the Early Burman”, p.35, n.96



Caption ။ အဟိကုန္ဒကဇာတ် ပေါ်ကုန်သည် ။

Figure 1 JĀ.365.Ahikundika *Jātaka*, Mentions *Capā Kun Sañ*, a Rice-merchant, Illustrated in

Myinkaba Kubyauk-gyi: Source: All the rare photos are supported by Than Zaw (Bagan)¹⁰

The social rank of *sukyway* is little slightly inferior than *sūthiy* whom is usually conferred the honorable title by the king. In the *jātakas*, the first story for rich man is mentioned in JĀ-39, Nanda *Jātaka*. The words, *saṃgi သံဂီ* in Mon and *sukrway သုကြွယ်* in Myanmar are applied and interpreted for rich man in the captions¹¹ of *jātakas*¹². Almost all the donors titled with *sukrway သုကြွယ်* are belonging to *sañ* family group whose names are usually attached with suffix, *sañ* or prefix *sañ lyañ* or *sañ krī* according to their social ranks _ the ordinary rank, the intermediate rank and the great rank respectively. All the commoners applied this naming custom by attaching these suffix and prefix but the slave names with attaching *sañ* as suffixes are not seen. So, it can be easily considered who possesses what social rank.

About the lives of *sukrway* are mostly mentioned in *jātaka* stories and the climax plot is usually depicted in mural scene. They were fundamental noble class of village communal life. They became rich concerning with agricultural occupation and agricultural related business i.e., the corn-trade and animal breeding. The wealthy men are labeled with *saṭhi သတ္တိ* in Mon and *saṭhiy သတ္တိယ* in Myanmar in the *jātaka* stories. The *saṭhī* or *sūthiy jātakas* represented to the class of wealthy man and the *saṃgi* or *sukrway jātakas*, the stories for rich men are captioned in the *jātaka* panels of Myinkaba Kubyauk-gyi and Wetkyi-in Kubyauk-gyi. Some examples of them are as follows:

¹⁰ Than Zaw (Bagan) is a tour guide, Bagan mural specialist and Bagan photographer who is a son-in-law of Minbu Aung Kyaing, an archaeologist.

¹¹ The caption mentions the serial number, the title and the professional or life of Bodhisattva of each *jātaka*.

¹² See Figure 2



Caption နန္ဒဇာတ် ဗောဓိသတ် ဒသ်ညး သံဂိ

နန္ဒဇာတ် သုကြွယ် ။၃၉။

Figure 2 *Samgi* in Myinkaba Kubyauk-gyi (left) and *Sukrway* in Wetkyi-in Kubyauk-gyi (right) Interpreted for Rich Man in JĀ.39 Nanda *Jātaka*

Saṭhī or Sūthiy Jātakas

JĀ-4 Cullakaseṭhi စူလကသေဋ္ဌိ

JĀ-103 Veri ဝေရီ

JĀ-171 Kalyāṇadhamma, ကလျာန ဓမ္မ

JĀ-238 Ekapada, ဧကပဒ

JĀ-315.Mam̐sa မံသ

JĀ-317.Matarodana မတရောဒန and

JĀ-363 Hiri ဟိရီ

Samgī or Sukrway Jātakas

JĀ-34 Maccha မစ္ဆ,

JĀ-39 Nanda နန္ဒ,

JĀ-43 Veluka ဝေဠုက,

JĀ-170 Kakaṇṭaka ကကဏ္ဍက,

JĀ-194 Manicora, မနိစောရ

JĀ-367 Saliya သာလိယ and

JĀ-390 Mayhaka မယက

The word *sathiy*, wealthy man is rarely found in inscriptions but many *jātakas* are interpreted as wealthy man for Bodhisattva professional life. The inscription recorded at the end

of dynasty shows that, *Sampyan Ciya Satthiy Krī*, the great wealthy man was given *mrañ plu lai 150 pay*¹³ (150 pay of the rice land of *mrañ plu* village) as a reward in accord to the social honorable rank of wealthy man.¹⁴ It is known that *sathiy* was regarded and honored by the king. In the Tayokphay inscription dated A.D.1255, he possessed the province, called *cayyasatthiy tuik* near *Panklī 10 tuik*¹⁵(Upper Chindwin areas). Nevertheless, *sathiy* and *sukrway* are related with agriculture and trade of agricultural product. The good examples of life-styles of *sathiy* and *sukrway* can be studied in *jātaka* stories mentioned above. Most are concerned with agriculture and agricultural related occupations.

The characters and background things of wealthy men are illustrated as village communal life-styles especially depicting with bullock carts. For instance, the *Jātakas*, JĀ-103 Veri ခေရီ and JĀ-315.Maṃsa ဓမ္မ of Myinkaba Kubyauk-gyi represented to village noble life-styles with the bullock carts as their properties and wealth.¹⁶ The wealthy man stood as an aristocracy in the village communal life based on agriculture and livestock. In the village community, there were also hereditary officials called *lay sukrī* _ the headman for Lands and revenues within the jurisdictional area of a village and *kī sūkrī*¹⁷ _ the head of crown granaries. They had to work under the supervision of *rwā sūkrī* _ village headman.

In the village community based on lands, the fundamental occupation was cultivation. There were ordinary agriculturalists i.e., farmers _ *lay sañ* or *lay su*¹⁸, the guardian of the fields and gardens_ *lay uyan coñ*²⁰, planters of paddy_ *capā cuik*²⁰, gardener_ *uyan sañ*²¹. Most of them are slaves and landless peasants who cultivated for landlord and for themselves. “The agricultural related professionals were *nwā thin*²² _cowherds, *klway thin*²⁴ _ buffalo herds, *chit thin*²⁴ _ goat-herds, *chan thin*²⁵ _elephant keepers and *wampay thin*²⁶ _tenders of ducks”.²⁷ Dr. Than Tun lists them as the groups of slaves but the professionals of this kind were not always slavery, some belong to *sañ* family groups or *asañ*, commoners.

¹³ (a)Pay or *pai*, ပယ် သိုမဟုတ် ပဲ is spelled in Bagan period for the unit of standard land measure. 1 *pai* would be equivalent to 1.77 acres.

(b)Dr. Than Tun, “History of Buddhism in Burma”, p.163, Appendix 1

¹⁴ (a)Pl.282²⁻⁵,

(b)U Nyein Maung, *ရှေးဟောင်းမြန်မာကျောက်စာများ* (Old Burma Inscriptions), vol. 3, Yangon, Archaeological Department, 1983, p.173 (Hereafter cited as OBI)

¹⁵ Pl.296¹⁷, OBI-II, p. 187 ပန်ကလီဆယ်တိုက်

¹⁶ See Figure 3

¹⁷ Pl.162²⁴, *kī sūkrī Rajakumtham*, Dr. Than Tun, “History of Buddhism in Burma”, p.42

¹⁸ Pl.193²⁶ Pl. 110⁷ လယ်သည်, လယ်သူ

²⁰ Pl.75a ³³ လယ်၇ ယန်စောင်

²⁰ Pl.175² စပါးစိုက်

²¹ Pl. 76² ၇ ယန်သည်

²² Pl.138¹³ နွားထိန်

²⁴ Pl.73 ⁴⁷ ကျွယ်ထိန်

²⁴ Pl.153 a¹⁹ ဆိတ်ထိန်

²⁵ Pl.76 ²³ ဆင်ထိန်

²⁶ Pl.183a ¹² ဝမ်းပယ်ထိန်

²⁷ (a)Dr. Than Tun, “Social life in Burma, A.D. 1044-1287”, *JBR*, Yangon, Burma Research society, Undated, p.40 (Hereafter cited as Dr. Than Tun, “Social life in Burma”)

(b) Dr. Than Tun, “History of Buddhism in Burma”, p.158



Caption ဝေရီဇာတ် ဗောဓိသတ် ဒသ် သဠိ (မံသဇာတ် ဗော)ဓိသတ် ဒသ် ကောန် သဠိ

Figure 3 JĀ.103 Veri ဝေရီ and JĀ.315. Mamsa ဓံသ Illustrated with Figures of the Bodhisattvas as Wealthy Men with their Bullock Carts, Myinkaba Kubyauk-gyi

“The food suppliers comprised of workers such as cooks, butchers and milkmen, *thaman sañ*²⁸ _rice cooks and *han sañ*²⁹ _ curry cooks, *May sañ*³⁰ _ butchers, *sācuiw*³¹ _ keeper of game and *muchuiw*³² _ hunters, *Puik sañ*³³ or *kwan sañ*³⁴ _ net men who supplied fish. Chewing betel was a regular practice and perhaps demanded specialized service. They had *kwañ sañ*³⁵, *kwañ toau sañ*³⁶, *kwañ si toau sañ*³⁷ and *kwañmwan taw sañ*³⁸ as servers of *kwañ ya*³⁹ _ betel quid”.⁴⁰ These inscriptional evidences of farming life can be linked with the visual evidences of *jātaka* stories.

A kind of food producers, a professional of hunting called *muchuiw* _hunter can be seen in JĀ-13 Kaṇḍina *Jātaka* ကဏ္ဍိန ဇာတ် and JĀ-21. Kuruṅga *Jātaka* ကုရုဏ် ဇာတ်. They were very important persons of village community and favoured by the king and royalty in the Bagan period. As the king was fond of the practice of hunting with the help of hunter, due to the inscriptions, it

²⁸ Pl.36¹⁶ ထမင်သည်

²⁹ Pl.36¹ ဟင်သည်

³⁰ Pl.153 a²² မယ်သည်

³¹ Pl.36¹⁹ သာစိုဝ်

³² Pl.71⁷ မုဆိုင်

³³ Pl.7⁹ ပိုက်သည်

³⁴ Pl.267⁴ ကွန်သည်

³⁵ Pl. 391¹³ ကွံသည်

³⁶ Pl. 476¹³ ကွံ တော်သည်

³⁷ Pl. 229^{18c} ကွံ သီတော်သည်

³⁸ Pl. 74²⁸ ကွံမွန် တော်သည်

³⁹ Pl. 139¹¹ ကွံယာ

⁴⁰ (a) Dr. Than Tun, “Social life in Burma”, p.41

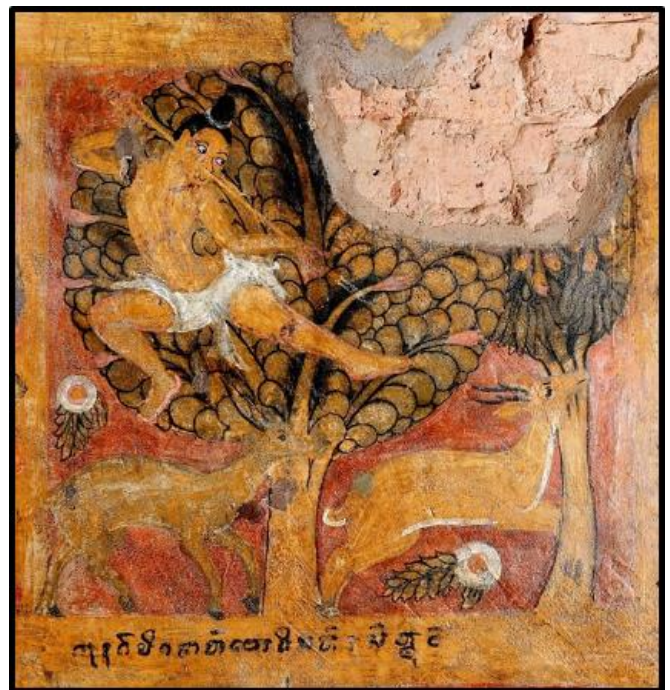
(b) Dr. Than Tun, “History of Buddhism in Burma”, p.158-159

can be said that they were taking place in the essential sector of the crown service. A *tuik*, called *Muchuiw-buil*, now Shwebo was named after the head of hunting occupation. In the illustration of the climax scene of JĀ-13, it can be seen that a folk hunter is shooting a stag down with an arrow which gone first across the village track and at the time the spirit in the tree has seen the event. It can be observed what kind of weapons the hunters used and how they hunt the game. In this figure, it is distinct that the hunter puts on the safety jungle boots that like even a high Deva who usually wear on his feet.⁴¹



Caption ကဏ္ဍကဇာတ် ဗောဓိသတ် ဒသ် ဒေဝတာဝ် ဆူ။

Figure 4 JĀ.13 Kanḍina Jataka, a Hunter with Bow and Arrow who Wearing Boots, Myinkaba Kubyauk-gyi



Caption ကုရုင် ပိဂဇာတ် ဗောဓိသတ် ဒသ် တွင်

Figure 5 JĀ.21 Kurunga Jātaka ကုရုင် ဇာတ် that Shows the Character of Hunter Called *Muchuiw* Who Used His Javelin, Myinkaba Kubyauk-gyi

The JĀ-21 mentions that Bodhisattva came to life as an antelope whereas there was a village hunter, whose method was to build a platform in tree at the foot of which he found the track of deer. When the deer came, he brought them down with a javelin, and sold the flesh for a living. The figure shows that the hunter in tree is in posture going to throw the javelin to an antelope.⁴² The attitudes of food producers, the hunters can be beautifully portrayed as well as each climax can be vividly extracted and depicted by Bagan muralists as the visual canon in Myinkaba Kubyauk-gyi.

For agricultural implements the farmers had especially the wooden-toothed Harrow (*thwan*) but the word, plough (*thay_ဆယ်*) is not mentioned in inscriptions so far. In fact, the figural

⁴¹ See Figure 4

⁴² See Figure 5

designs of the plough (*thay*) have also not seen in visual evidences. The farmers had also used the hoe (*poktu*), the axe (*puchin*)⁴³ and the fork (*khak*) and the Cart (*lhañ*). They are purely native words. In the plain regions they regularly used yoked bullocks (*thwan nwā*) or water-buffaloes for harrowing.

In JĀ-45, *Rohiṇī Jātaka* scene⁴⁴ of Myinkaba Kubyauk-gyi, the implements for food production can be seen. These are Myanmar traditional rice pounding mortar and pestle. The story said that Bodhisattva was born a son of the Lord High Treasurer and came to be Lord High Treasurer himself. He had a maid-servant whose name was Rohanī. In order to drive the flies off, she struck her mother with a pestle so her mother died on the spot.⁴⁵



Caption ရောဟိနီဇာတ် ဗောဓိသတ် ဒသ် သဠိ

Figure 6 JĀ.45, *Rohiṇī Jātaka*, a Story of Wealthy Man, Myinkaba Kubyauk-gyi Shows Farming Tools

The similar story is JĀ-44, *Masaka Jātaka* which suggests one to avoid the danger of stupid friends. The story tells us that the Bodhisattva gained his livelihood as a trader. A son of carpenter chopped his father head with a sharp axe or adze⁴⁶ in order to kill only the mosquito. So the old man fell dead on the spot. The Bodhisattva, who had been an eye-witness of the whole scene, said that the sense-lacking friends are worse than foes with sense. This *jātaka* panel of Myinkaba Kubyauk-gyi shows a kind of local traditional implement, the hand adzes in the hands of two carpenters.⁴⁷

The glaze plaque of Ananda that belongs to Kiccanakkhana *Jātaka*, JĀ-56 shows how Bagan farmers were ploughing and harrowing their rice-fields with yoked bullock and harrow (*thwan*). The text of *jātaka* mentions that a famer, Bodhisattva found a huge bar of gold in the field by hitting with the plough but he could not lift it. He managed to cut the gold into four pieces in order to live on, to bury as a treasure, to trade with, and for charity and good works. After division he could carry easily and he bore home the lumps of gold. The scene of green glaze plaque is simply depicted with single bullock and a harrow (*thwan*) as well as the background is vividly filled with a tree. Bodhisattva is driving the bullock with the cane.⁴⁸

⁴³ Pl.72⁸, Pl.310a³² *Puchin 10 cān* ပုဆိန် ၁၀ စာင်

⁴⁴ *Rohanī Jātaka* ရောဟနီ ဇာတ် a *jātaka* of wealthy man, Myinkaba Kubyauk-gyi

⁴⁵ See Figure 6

⁴⁶ The *jātaka* mentions bifacial axe but the figure of Myinkaba Kubyauk-gyi shows unifacial hand adze.

⁴⁷ See Figure 7

⁴⁸ See Figure 8



Caption မသကဇာတ် ဗောဓိသတ်ဒသံ ညးဗနိုက်

Figure 7 JĀ.44, Masaka *Jātaka* that Shows the Character of Two Carpenters who Used the their Axes or Hand Adzes Called *Puchin*, Myinkaba Kubyauk-gyi



Caption ကဉ္စနခန္ဓ ဇာတ်

Figure 8 *Jātaka* JĀ.56, Farming Life-style of Kiccanakkhana, Ananda Glaze Plaque

It is very interesting that according to the text of *jātaka*, the ink glosses of Mon and Myanmar interpret the livelihood of Bodhisattva as a ploughman in JĀ-56 called *ñah majik*⁴⁹ in Myinkaba Kubyauk-gyi and as a trader of gold called *rhuy kun sañ*⁵⁰ in Wetkyi-in Kubyauk-gyi and Salay-13 temple. The Burman refers the kind of the last professional life of bodhisattva but the Mon, the earlier life. The word *ñah majik* or *juṃwik* in old Mon can be identified as “one who uses the harrow.”⁵¹

⁴⁹ (a) See Figure 9

(b) *ñah majik* ညးမဇိတ် (လယ်ထွန်ယောကျ်း)

⁵⁰ *Rhuy kun sañ* ရှယ်ကုန်သည်

⁵¹ Luce, “The Economic Life of the Early Burman”, p.349, n.43

The other visual evidence shows the simple hoe called *poktu* as an important implement of cultivator. This implement can be seen in JĀ-70 Kuddala *Jātaka*⁵² depicted in the mural panels of many temples and plaques of many stupas in Bagan. The Bodhisattva was named after his occupation as *han cuik sa sū* which means one who plants the vegetables called *han* in the garden according to the captions of Wetkyi-in Kubyauk-gyi.⁵³



Caption (ကုဉ္ဇနက္ခန္ဓ) ဇာတ် ဗောဓိသတ် ဒုသ်ညးမဇိတ်

Figure 9 JĀ.56, Kiccanakkhandha, Ploughman Called *Ñāh Majik*, in Mon, Myinkaba Kubyauk-gyi

The story says that the Bodhisattva came to life again as a vegetable gardener. One day to renounce the world for the religious life, he hid his hoe away, and became a hermit. But thoughts of that hoe rose in his heart and the passion of greed overcame him, so that for the sake of his hoe he reverted to the world. Again and again, this happened six times but the seventh time he flung it into a great river. Then he loudly shouted that he had conquered. Now just at that moment the King of Benares, the conqueror of the battle asked the gardener whom he had conquered. The Bodhisattva replied the King that his victories are vain, if he had not the victory over the Lusts within himself and Bodhisattva continued that he had conquered his Lusts. The scene of JĀ-70 is portrayed and depicted with the figures of the last climax episode.⁵⁴

Moreover, a scene without the caption of Myinkaba Kubyauk-gyi clearly shows the life-style of farmer who is ploughing his field with a pair of yoked bullocks and probably his wife in the house is longing to him. It is noted that Bagan farming life-style is not much different from those of modern farmer in Myanmar.⁵⁵

The very interesting practice of land transaction frequently occurs in the inscriptions. “At the end of a land transaction, when the business was over, the two parties sat down to a feast. The feast for which one whole ox and seven pots of liquor were reserved must have been a fairly big one. This practice of feasting became popular from the middle of the 13th century onwards. The spending money of liquor and oxen are called *siy phuiw sā phuiw*”.⁵⁶ The pot containing liquor is

⁵² ကုဒလဇာတ် Kuddala Jataka

⁵³ ရိသိ risi - hermit in Myinkaba Kuinkaba Kubyauk-gyi တင်စိုက်သသူ han cuik sa su _ Vegetable-gardener in Wetkyi-in Kubyauk-gyi.

⁵⁴ See Figure 10

⁵⁵ See Figure 11

⁵⁶ Pl.224¹⁰⁻¹¹, Dr. Than Tun, “History of Buddhism in Burma”, p.121, “*Siy phuiw sā phuiw* သိယံစိုက်သသူ” literally means the price of liquor and the price of meat

*siy auiw*⁵⁷ that can be seen in the *jātaka* panels. A rich man (*saṃgīh* in Mon) *jātaka*, called JĀ-47 *Vāruṇī Jātaka*⁵⁸, mentions about the story of tavern. The characters of this narrative story represent to the livelihood of common people who sell the liquors which is very important for feasts and festivals. In the scene, Bodhisattva, a rich man converses with the tavern-keepers who have beards around a liquor pot.⁵⁹ The *jātaka* stories with captions and illustrations tell about social life and life-styles of Bagan common people.



Caption ကုဒ္ဒလ ဇာတ် ဗောဓိသတ် ဒသ်ရိသိ

Figure 10 JĀ 70 Kuddala *Jātaka* Bodhisattva Mentioned for Final Life as *Risi* _ Hermit, Myinkaba Kubyauk-gyi

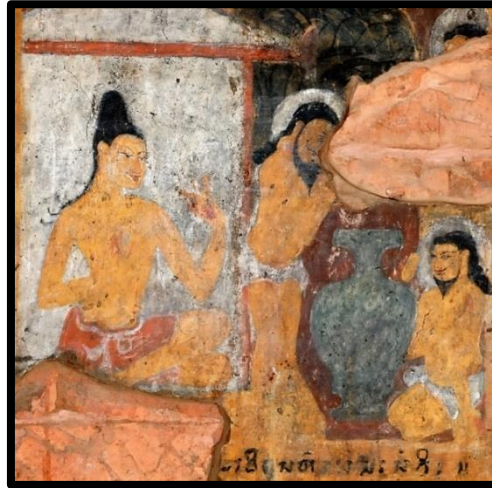


Figure 11 Scene without Caption Shows the Life-style of Farmer, Myinkaba Kubyauk-gyi

⁵⁷ သိယ်အိုဝ်

⁵⁸ JĀ-47. *Vāruṇī Jātaka*, *saṃgīh* ဝါရုဏီ ဇာတ် သံဂီ

⁵⁹ See Figure 12



Caption (ဝါရုဏီ)ဇာတ် ဗောဓိသတ်ဒသံ ညးသံဂိး ။

Figure 12 JĀ.47. Vāruṇī *Jātaka*, Life-style of Tavern-keepers and Rich Man before a Liquor Pot, Myinkaba Kubyauk-gyi

The main agricultural related professionals are merchants who mainly used carts and boats. The counterparts of land lords had also existed as *kun sañ*, the merchants in the elite society of Bagan kingdom. The word, *kun sañ* has never seen in epigraphic evidences but many evidences are found in mentioned notes in *jātaka* stories. Many stories concerned with trade and commerce are mentioned in Nipātas, but some Bodhisattva's careers of *jātakas* are vividly labeled and interpreted as 'banik' in Mon at Myinkaba Kubyauk-gyi and *kun sañ* in Burman (Myanmar) at Wetkyi-in Kubyauk-gyi for merchant class. They mainly used both the land and riverine routes or sea routes for trade and commerce. In the scenes of *jātakas* and *Mahā Buddhavaṃ*, the vehicles and cargos they used can be seen as bullock carts and boats. There are called *lhañ* for cart and *lhiy* for boat. The master of carts is interpreted as *lhañ kun sañ*⁶⁰ (literally caravan merchant) in *jātaka* stories as well as the master of boats as *lhiy sma* (literally master mariner)⁶¹.

According to the above pictures, it can be noticed that the term, *kunsañ*, meaning merchant that have never been in inscriptions so far can be discovered in mural scenes. Moreover, the goods were carried by merchants with their related vehicles and it can be safely assumed that the merchant class had existed since Bagan period. In fact, daily life of Bagan commoners and their implements are inserted and illustrated in the scenes of previous lives of Buddha.

The ways of life and socio-economic life cannot be illustrated without a study of slaves' vocations. Many professionals and skill persons are usually found in the list of slaves dedicated to pagoda and monastery. Some *asañs* had fallen down to slavery as the debtor slaves or captive slaves because of their debts, *mriy* or keeping captive. Primarily, there are the agriculturalists

⁶⁰ (a) ဟုဉ်ကုန်သည် JĀ.1. Apanṇaka, JĀ.2. Vaṇṇupatha, JĀ.54. Phala, 85. Kaṃpakka, and 256. Jaruṇḍapāna of Wetkyi-in Kubyauk-gyi (b) See Figure 13

⁶¹ (a) ဟိုယ်သော JĀ.466. Samuddāvaṇija, JĀ.463. Suppāraka, Wetkyi-in Kubyauk-gyi (b) See Figure 14

comprised of farmers,⁶² the guardian of the fields and gardens⁶³, planters of paddy⁶⁴, granary keeper⁶⁵, gardeners⁶⁶, cowherds⁶⁷ and buffalo herds⁶⁸; secondly the workers can be regarded as rural land related professionals such as for the food suppliers, rice cooks⁶⁹ and curry cooks⁷⁰, butchers⁷¹, oil producers⁷², milkmen⁷³, keeper of game⁷⁴ and hunters⁷⁵ as well as for making



Caption အပတ္တက ဇာတ် ။ သုပါ(ရဇာ)တ်။ ဗောဓိ သတ်ဒသ ဗနိက် ။

Figure 13 (left) JĀ.1 Apannaka *Jātaka*, Caravan Merchant, Ananda

Figure 14 (right) JĀ.463 Suppāraka *Jātaka* that Shows Sail Boat with Three Mariners, Myinkaba Kubyauk-gyi

and tray makers⁷⁸, for making clothes: spinners⁷⁹, loincloth makers⁸⁰, and weavers⁸¹.⁸² pots and pans: potters⁷⁶, jug makers⁷⁷

⁶² lay uyan coñ လယ်ဥယျာဉ်စောင့် pl.75a³³

⁶³ lay uyan coñ လယ်ဥယျာဉ်စောင့် pl.75a³³

⁶⁴ capā cuik စပါးစိုက် pl.175²

⁶⁵ Kīcoñ ကိစောင့် pl.19ab³³

⁶⁶ uyan san ဥယျာဉ်စောင့် pl. 76²

⁶⁷ nwā thin နွားထိန် pl.138¹³

⁶⁸ klway thin ကျွယ်ထိန် pl.73⁴⁷ klway nwā thin pl.365c⁷

⁶⁹ thamañ sañ ထမင်းသွပ် pl. 36¹⁶⁻¹⁷

⁷⁰ hañ sañ ဟင်းသွပ် pl. 36¹⁷⁻¹⁸

⁷¹ may sañ မယ်သွပ် pl.153 a²²

⁷² chañ chum sañ ဆည်ဆုတ်သွပ် pl.417¹²

⁷³ Nwā nuiw sañ နွားနို့သွပ် pl.36¹⁸

⁷⁴ sācuiw သာဇိတ် pl. 36¹⁹

⁷⁵ muchuiw မှုဆိတ် pl. 71⁷

⁷⁶ uiw thin ခိုထိန် pl. 392¹¹

⁷⁷ kara sañ ကရာသွပ် pl. 216³⁰

⁷⁸ lañpān sañ လင်ပန်သွပ် pl.164²⁵

⁷⁹ khrañ sañ ချည်ညွှပ် pl.391³⁶ and khrañ ñay sañ pl. 393²⁸

⁸⁰ pukhrañ sañ ပုချည်သွပ် pl.392³⁰

⁸¹ yan sañ ယန်သွပ် pl.164²¹

⁸² (a) Dr. Than Tun, "Social life in Burma", pp.40-42

Conclusion

The staff of life of Bagan was paddy, *capā* which is mentioned in the inscriptions and *jātaka* captions. The rice field was called *lai* or *lay* measuring in the unit of *pay* which is equal to 1.77 acres. According to the inscriptions, the most manors of lands were occupied by aristocrats such as land lords, wealthy man, leading land owner, land agent and merchant. They are usually mentioned in inscriptions and depicted in narrative stories as the visual evidences and visual images on the walls of Bagan temples. The images with captions of the stories reflected and discovered the socio-economic life and life-style of Bagan people. About the lives of *sukrway*, rich men are mostly mentioned in 550 *jātaka* stories. The word meaning merchant or trader has never been seen in inscriptions but the life and life-style of merchant class with the word, *kun sañ* are illustrated in the narrative stories. Moreover, the farming tools and implements which Bagan people used can be studied in mural scenes of *jātaka* stories. The tools and implements are not different from those of modern Myanmar. The village communal life is divided into two groups of professionals such as agriculturalists and land related professional. There were ordinary agriculturalists i.e., farmers, the guardian of the fields and gardens, planters of paddy, gardener and granary keeper. Most of them are slaves and landless peasants who cultivated or worked for landlord and for themselves. “The agricultural related professionals were cowherds, buffalo herds, goat-herds and tenders of ducks. Their life-styles were vividly illustrated in mural *jātaka* stories on the walls of the most temples during the Bagan period.

Acknowledgements

First of all, I would like to thank Dr. Nay Win Oo, Rector of East Yangon University, and Dr. Aye Aye Ko, Dr. Wah Wah Lwin and Dr. Thidar Aung who are Pro-Rectors for permission to this research study. In my department, my special thanks go to Dr. Wah Wah Thein, Professor, Head of department and my colleagues for their continuing encouragement of my research.

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Appendix 1
*
Transliteration Table

1. Consonants

က	ka	စ	ca	င	ta	တ	ta	ပ	pa	ယ	ya	သ	sa
ခ	kha	ဆ	cha	ဌ	tha	ထ	tha	ဖ	pha	ရ	ra	ဟ	ha
ဂ	ga	ဇ	ja	ည	da	ဒ	da	ဗ	ba	လ	la	ာ	m
ဃ	gha	ဈ	jha	ဗ	dha	ဓ	dha	ဘ	bha	ဋ	la	အ	a
င	na	ည	ña	ဏ	ṇa	န	na	မ	ma	ဝ	wa	သ	ssa

2. Vowels

အ	a	အာ	ā	ဣ	i	ဤ	ī	ဥ	u	ဦ	ū
ဧ	e	ဧ	è	ဧ	e,						
ဩ	o	ဩ	ò	ဩ	ó	ဩ	ô				

3. Combinations

ိ	i	ိ	ī	ု	u	ူ	ū	ေ	e	ေ	o	ိ	ui
ဲ	ai	ဲ	au	ု	y	ဲ	r	ဝ	w	ဲ	h	အ	or -ာ
-က	k	-င	n	-စ	c	-တ	t	-ပ	p	-ည	ñ	-ဝ	w

4. Numerals

၁	1	၂	2	၃	3	၄	4	၅	5	၆	6	၇	7	၈	8	၉	9	၀	0
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* See also Than Tun, History of Buddhism in Burma A.D. 1000-1300', *Journal of Burma Research Society*, LXI, i & ii, December, 1978,p.ii

AN ETHICAL ANALYSIS OF THE *LOKANITI*

Tin Tin Sein*

Abstract

The aim of this paper is to evaluate the moral and social prescriptions of the *Lokaniti* from the philosophical viewpoint. The research problem is “The *Lokaniti* has played an important role in developing and promoting moral awareness and understanding throughout the ages and are still relevant today.” The *Lokaniti* is mainly concerned with the meaning of moral worth in this life. The descriptive and evaluative methods will be used. To prove this an evaluation will be made by the principle of deductive reasoning. This research paper will contribute towards understanding that ancient texts such as the *Lokaniti*. It should not be rejected outright, for it can still play a role in instilling and strengthening awareness of the need for morality and ethics in life today.

Keywords: Moral Awareness, Philosophical Viewpoint, *Lokaniti*, Intellectual implication

Introduction

A philosophical and ethical analysis of *Lokaniti* aims to show to what extent each stanza is rationally acceptable, and to consider whether it is still relevant to the present situation and to examine whether it is ethically, socially and intellectually functional for observation in daily life. It can be found that some stanzas of *Lokaniti* do not fit in with the present situation although it is traditionally and culturally accepted as a guideline for good social relationship, for good conduct.

This paper is based entirely on the translation into English by Dr Sein Tu of the *Lokaniti* treatise written originally in Pali and its translation into Myanmar prose by the Venerable U Buddha during the reign of Myanmar King Bagyidaw (AD 1819-1837). *Lokaniti* is the work of Caturangabala who lived in the fourteenth century AD and was minister in the court of King Thihathu (AD 1350-1359). In making an analytical study of the *Lokaniti*, this paper has combined the original seven chapters under four headings on Knowledge and the Good Man, Social Relations, Ruler and Subject and Sundry Matters for the sake of brevity and to also highlight the interconnections of the moral values and social mores of the original text.

Most Myanmar traditionally value and learn the *Lokaniti* because it highlights the needs for all people to treat one another with mutual respect and consideration on the basis of social and ethical values. *Lokaniti* is a valuable guideline that closes the gap between theory and practice. It teaches individual members of society how to be morally and socially the responsible in accordance with his or her position in society. However, *Lokaniti* is accepted as ethical, social and intellectual guideline, whether it can motivate contemporary people, as it did before, needs to be examined. On the other hand, it is important for contemporary men to understand the nature of universal ethical concepts that need to be observed without depending on the particular situations, and to understand that some universal ethical concepts need to be particularized so as to give more practical guideline for those who are involved in different professions.

Therefore, the *Lokaniti* should be evaluated from the philosophical point of view. It can also be said that making a philosophical analysis of *Lokaniti* will be a guide to accept what is rationally acceptable in the *Lokaniti* and to remove or modify or reject whatever is rationally unacceptable or outmoded.

An Evaluation of the *Lokaniti*

Lokaniti is the most prominent moral literary work in Myanmar. Historically, as mentioned

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in an earlier chapter, the **Lokaniti** was written in Pali by Caturangabala, minister of the royal court during the fourteenth century. It was written in the Myanmar Era year (714) during the reign of King Thihathu (A.D 1350-1359). This Pali version was later translated to the Myanmar Language by Sayadaw U Buddh in the year 1824. The last King of Myanmar, King Thibaw also had the **Lokaniti** translated into Myanmar verse by Nay Myo Min Htin Kyaw Khaung U Shin Galay and published as the **Lokaniti** Pyo. The '**Lokaniti**' literally means a guide to life. In essence, its main focus is on how to live a good life. The moral prescriptions of the treatise are based on the fundamental principles of Theravada Buddhist ethics and this is made explicit in the prologue with obeisance to the three Gems, the Buddha, Dhamma (The Law) and Sangha (The community of Buddhist monks). Yet it exemplifies a typical Myanmar way of ethical thinking that is both realistic and pragmatic. In a way, it is a portrayal of the Myanmar national character as a whole regardless of ethnic differences.

Evaluation of Knowledge

To begin with, the **Lokaniti** after the prologue touches upon the learning, knowledge and wisdom in the chapters on the Sage, the Good Man and the Base and Foolish Man. It is clearly stated in these chapters that morality comes only with knowledge and in a way, this has some similarity with the ancient Socratic view that "Virtue is Knowledge" and that no one does evil knowingly.

In Buddhist terms it holds that wrongdoing is due to ignorance and one will suffer its consequences. Therefore, the **Lokaniti** goes on to explain why a lazy man without learning can acquire neither wealth nor friends and how a man without friends cannot be happy and implies that without happiness one cannot attain *Nirvana* (nibbana) that is liberation from all kinds of suffering. This value placed on learning and wisdom is the ethical essence of the Buddha's teachings; Knowledge is thus of primary importance to live a good life and this view is still alive today in Myanmar society.

Knowledge of any kind whether of the arts or sciences, martial arts or even arts and skills to earn a livelihood, is not to be considered of little or no consequence, for it makes life better in many ways. So, practical skills as well as theoretical knowledge, each has value in its own way.

This is stated clearly in the **Lokaniti** thus;

Despise not knowledge of the arts and sciences as being of little consequence, when properly acquired such knowledge may provide the means of livelihood.¹

Policy makers in education have started to take note of this important view today which has long been present in Myanmar educational thought as shown in the **Lokaniti**. But it still needs to reach the general public, especially well-to-do parents who seem to think that learning and education means degrees in science and technology.

Advice is also given to apply oneself to daily learning for it says;

Study increases learning,
Learning increases knowledge,
Knowledge brings understanding
And Understanding brings peace.²

This piece of advice seems to foreshadow the need for lifelong learning that is being advocated today, but it goes farther to include the benefits of knowledge as not only book

¹ Dr.Sein Tu.(2001). **Lokaniti**. Yangon, Myanmar: Innva Publishing House. P.6

² Ibid., p.21.

knowledge but to instill understanding in the interest of peace. The Myanmar have always valued knowledge and wisdom and parents often say to their children that education is the best legacy that they can give them.

It also clearly spells out the moral, social and political of having and not having knowledge. The *Lokaniti* praises the sage as one who remains consequences undisturbed even when faced with misfortune. The *Lokaniti* was written in the days of the monarchy when class distinctions were accepted as the norm and there was discrimination between the high-born and low-born, yet in one stanza on The Sage it said that through knowledge this distinction could be overcome.

Evaluation of Social Relations

The *Lokaniti* also lays great emphasis on good social relations which depends on having friends but it is realistic enough to remind people that wealth too is important. With regard to friends it says in effect in the first two lines of the opening verse in Chapter IV, that the person who promotes one's well-being can be considered a friend even though he may be a stranger, and a so-called friend who does not care for your comfort and security is surely a stranger. It also goes on to say in Verse 80 that a person who speaks ill of another in his absence but is full of praise when face-to-face cannot be considered a friend. With regard to wealth it says in Stanza 81 that;

Should one but lose one's wealth, one loses friends, wife, children, and brothers as well.
These cleave only unto the prosperous.
Therefore, wealth is, in this life, the truest friend.³

This is a truly negative view of human nature, but it cannot be denied that in human society in general, wealth is considered good and poverty, bad. Wealth may not be the truest friend but it can solve many problems. It may be a reminder that most people are not to be trusted until they have been tried and tested over time; that one should wait and see before trusting a person, whether wife, friend or brother. It sometimes shows that human nature can be dreadful and evil. This could be the case for it warns in stanza 84:

Do not be intimate with a foe:
Do not be intimate with a friend;
For that friend may later, in anger,
Reveal all one's faults.⁴

This piece of advice is based on the fact that people change with time and circumstance. The *Lokaniti* does not imply that there are no good friends. That is not the case. As mentioned above it only points out that people should be careful in their social relationships. And this is made clear in the verse 92,

The friend who, in times of sickness, or famine,
Or poverty, or when one is in the hands of enemies,
Or at the prison gates, or at the graveyard
Remains steadfast and loyal, that friend is to be deemed a true friend.⁵

The *Lokaniti's* outlook concerning social relationships would not be complete without comment on its views on women. Generally, it may be said that there are traces of the Indian influence which regards women as inferior to men and untrustworthy as well. It says most unfairly that even the most faithful wife will be "undone" if she is away from the husband for a month. It

³ Ibid., p.81.

⁴ Ibid., p.84.

⁵ Ibid., p.92.

acknowledges the fact that beauty is to be found in women but their role is to serve men and be good wives and mothers.

Evaluation of Ruler and Subject

In this section moral guidelines are laid down for both ruler and subject, but it also refers to certain principles of Myanmar political thought.

The period of the **Lokaniti** was when the rule of monarchy prevailed and the King's power was absolute. The King was ruler and owner of the entire Kingdom including his subjects but such rights were not without duties and obligation for both parties. This is made clear at the outset of Chapter VI in stanza 112 which states:

A King may sleep but one watch of the night;
A sage may sleep but two watches of the night;
A householder may sleep but three watches of the night;
A beggar may sleep all four watches of the night.⁶

Unlike his subjects, the ruler has always to be on the alert and cannot enjoy a full night's sleep. Likewise, subjects under his rule were entitled to a period of sleep in accordance with his position in society. In modern terms this can be interpreted as having greater responsibilities in accordance with one's rank in government or position in society. This is as true in a monarchy as in a democracy. All leaders bear greater responsibility and accountability. This view found in the **Lokaniti** is still relevant today.

The king is responsible for the welfare of his subjects but the subjects also have duties and obligations. There is no reference to freedom in the **Lokaniti** but there is a clear guideline for each to fulfill their assigned duties and obligations including the king. There are no charters or contracts in written form but only part of practice and tradition handed down through generations. The **Lokaniti** also emphasizes the fact that a king or a leader must possess certain qualifications to be worthy of his position. They are stated in stanza 119 as follows;

Forbearance, vigilance, industry, generosity,
Compassion and foresight: these are the six
Attributes of leaders: these are the qualities
desirable in the good man.⁷

Nowadays, there are many training courses for leadership in Myanmar. So it is important to note that an ancient text such as the **Lokaniti** contained advice on good leadership. The qualities mentioned in the above verse are also said to be the qualities of a good man. In short the **Lokaniti** implies that not only the king but also those who assist in governing the land must have certain attributes if the kingdom, country and society are to progress.

Conclusion

The **Lokaniti** as shown above is a treatise that provides moral and social guidelines for everyday life for people of all classes, ruler or ruled, rich or poor, and even for monks. It has played an important role in the emergence and development of Myanmar language and literature and still exerts influence on Myanmar literature and Myanmar life.

A study of the **Lokaniti** will show how Myanmar ethical and moral thinking progressed through the years. What is more important is that it will clearly show how human society today (including Myanmar society) has changed drastically with the advances made in science and technology. Yet it can be said that however much human life and relations may have changed certain basic moral principles and values have to be adhered to if the human race is to survive; that

⁶ Ibid., p.112.

⁷ Ibid., p.119.

some moral principles and values still endure. Moral prescriptions and guidelines however do not remain the same. Human society changes over time together with advances made in knowledge and experience. So, a study of the ancient morality of the past will provide valuable insight as to which moral rules and values are more enduring and which must be replaced by new rules that are more suitable for contemporary times. The *Lokaniti* is a treatise that treats customary morality as well as reflective morality. A study of its tenets will provide knowledge of the moral foundations of Myanmar Society.

As stated above, in this process the *Lokaniti* played a significant role. It's realistic and pragmatic trend of thought and its clear and expressive verses have undoubtedly contributed to Myanmar philosophy and morality as well as to the Myanmar way of life. Another notable point about Myanmar culture and tradition is the value placed on knowledge and education. The *Lokaniti* places great value on the acquisition of all forms of knowledge and this tradition is still very much alive today in Myanmar.

Likewise, although certain social mores of the *Lokaniti* are now out-of-date the basic ethical principles and values it advocates resonate with the Myanmar people and are still a source of instilling moral sensitivity and consciousness in the young. Life cannot be lived without moral or social rules. This means that children need to be taught from young the difference between what is good and what is bad or what is permissible or not in human society. That is why although life styles may change and certain social relations may have to change with the times there are certain moral norms and values that endure for all time.

Acknowledgements

I would like to thank Rector Dr Nay Win Oo and Pro Rectors Dr Aye Aye Ko, Dr Wah Wah Lwin and Dr Thida Aung, East Yangon University for permissions and suggestions.

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စန်းငွေ၊ဒဂုန်ဦး။(၁၉၈၉)။ စာဏာကျနီတိကျမ်းနှင့်သိ ဂါလောဝါဒသုတ္တန်။ ရန်ကုန်မြို့။သာသနာရေးဦးစီးဌာနစာကြည့်တိုက်။

သုခဦး။(၂၀၁၈)။လောကနီတိ။ ရန်ကုန်မြို့။ သုခစာပေ။

ဦးဖေ။(၁၉၄၁)။လောကနီတိပျို့။ ရန်ကုန်မြို့။ ဟံသာသီရိစာပုံနှိပ်တိုက်။

A STUDY ON THE RELATIONSHIP BETWEEN LOCUS OF CONTROL AND LEARNING PERFORMANCE OF UNIVERSITY STUDENTS

Htar Htar Khin^{*}

Abstract

The purpose of this study was to investigate how locus of control influences the learning performance of university students. Two hundred and seventy-eight Dagon University students ranging from 18 years to 24 years of age participated in this study. The sample consisted of 153 males and 125 females. Myanmar adaptations of the Internal-External Locus of Control Scale and Learning Scale were used to tap levels of Locus of control and seven dimensions of learning performance among university students. The results of this study revealed that internal locus of control had a significant positive influence on reading and negative influence on listening. No significant associations were found between locus of control and other learning performance dimensions. The results of this study revealed that there were some differences in learning performance between gender groups. Male students were significantly higher in perception/understanding factors than females. In contrast, female students were found to be significantly higher in the listening factor than males. There were no significant differences between males and females in concentration, abilities, method, reading, and noticing factors. Students' learning performance was also compared between two age groups. No significant differences were revealed between aged 18 to 20 years and over 20- years of age groups. Recommendations were offered for the application of locus of control to the teaching and learning process and future research.

Keywords: Locus of Control, Learning Performance, University Students

Introduction

In the field of student learning and performance, a great deal of research has focused on explaining why some learners are more successful than others. How individuals perceive the world and themselves play a vital role in their learning. One important area which is related to how learners perceive themselves is Locus of Control (LOC). Locus of control refers to one's belief in his or her abilities to control life events (Rotter, 1966). This concept has an essential place in literature in helping students who have difficulty in learning and attitude. It is one of the vital concepts in the context of learning difficulty and attitude change.

A person's "locus" (Latin for "place" or "location") is conceptualized as either internal (the person believes they can control their life) or external (meaning they believe that their decisions and life are controlled by environmental factors which they cannot influence, or by chance or fate). Individuals with a high internal locus of control believe that events in their life derive primarily from their actions: for example, when receiving test results, people with an internal locus of control would tend to praise or blame themselves and their abilities, whereas people with an external locus of control would tend to praise or blame an external factor such as the teacher or the test. Thus, locus of control covers the idea that individuals, throughout their lives, analyze the events as their attitudes or they believe that those events result from chance, fate or outside forces (Erdogan, 2003).

Internal locus of control has been linked with academic success (Gifford, Briceño-Perriott & Mianzo, 2006), higher self-motivation and social maturity (Nelson & Mathias, 1995). Internal or external locus of control plays an important role for students to sustain the efficacy and usefulness of learning performance. The knowledge and experiences gained by the students by

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means of organizational Learning are a vital factor in increasing student performance. In this context, it is necessary for educational organizations to fulfill learning function in an arrangement and to use this function oriented to the improvement of the students (Kutanís et al., 2011).

The present study examines whether Myanmar university students have the internal or external locus of control; furthermore, which locus of control they possess in the learning period. It will be observed to what extent and how locus of control relates to learning performance. For these reasons, the issues of locus of control (internal-external) and learning performance have been the focus of this study.

Objectives of the study

The present study was aimed to meet the following objectives:

1. To understand the locus of control of Myanmar university students;
2. To explore the differences between student learning performance among demographic groups; and
3. To examine how locus of control influence learning performance of university student.

Method

Participants

The participants in this study were 278 Dagon University students ranging from 18 years to 24 years of age. The sample consisted of 153 males and 125 females. The participants were chosen from Zoology, Geology, Industrial Chemistry, Physics, History, Law and Anthropology departments. Demographic characteristics of the participants are listed in Table 1.

Instruments

Learning performance was measured by using Myanmar adaptation of Learning Scale developed by Güngör (2006). The Learning Scale (LS) assesses seven dimensions of Learning performance, which are concentration, perception, listening, abilities, method, reading and noticing and included 25 items. Items are worded to accommodate the use of a 5-point scale ranging from (1) "strongly disagree" to (5) "strongly agree." Scoring was reversed for negatively keyed items. Students' locus of control was assessed by using Myanmar adaptation of Internal-External locus of control scale developed by Rotter (1966). Locus of control scale consisted of 23 items. The higher score on locus of control scale indicates the higher level of an individual's internal locus of control.

Procedure

The Learning Scale (LS) and Locus of Control Scale (LOC) were administered to the participants from the seven departments in Dagon University. They were requested to read the instructions stated on the questionnaire carefully and also informed that all responses were confidential. The time taken to answer the questionnaire was about 25 minutes.

Data Analysis Techniques

The data analysis was done by descriptive statistics and parametric techniques. Descriptive statistics was used to present the data in the form of tables and to describe variables under study in terms of means, standard deviations and intercorrelations among variables.

In this study, independent samples t-tests, correlation and regression analyses were performed to test the hypotheses formulated. All data were coded and fed into the computer and calculations were made with the aid of Statistical Package for Social Sciences (SPSS) program.

Table 1- Demographic Characteristics of the Participants

Demographic Characteristic	f	%
Gender		
Male	153	55.00
Female	125	45.00
Total	278	100.00
Age		
18-20 yrs.	219	78.78
21-24 yrs.	59	21.22
Total	278	100.00
Education		
2 nd yr.	103	37.10
3 rd yr.	175	62.90
Total	278	100.00
Specialization		
Anthropology	33	11.90
Botany	12	4.30
Geology	54	19.40
History	7	2.50
Industrial chemistry	48	17.30
Law	71	25.50
Physics	28	10.10
Zoology	25	9.00
Total	278	100.00

Results And Discussion

Descriptive Analysis Results

Items that measure learning performance factors were formatted into a 5-point response dimension. For each measure, item scores were summed and the mean was taken. Thus, there is a possible range of scale scores from one to five. Locus of Control Scale comprised of dichotomously scored-items and scored 1 for internal locus of control, and 0 for external control. Those items with poor discrimination power from LOC and learning performance scales were dropped. Descriptive statistics and the zero-order correlations for all variables examined in this study are presented in Table 2. As listed in Table 2, the absolute value of correlations among the variables of interest ranged from .02 to .36. The mean scores of the variables ranged from 3.21 to 4.08, and from .66 to 2.16 of SDs. According to table 2, locus of control was found to have significant positive correlation with reading factor and negative association with listening factor. Significant intercorrelations were also found between learning performance factors.

Comparison of Learning Performance between Demographic Groups

Learning performance factors were compared between two gender groups. Table 3 presents the results. As noted in the table, male students were significantly higher in perception/understanding factor than females. In contrast, female students were found to be significantly higher in listening factor than males. There were no significant differences between males and females in concentration, abilities, method, reading, and noticing factors.

Table 2- Mean, Standard Deviation, and Zero-order Correlations among the Variables

Variable	Mean	SD	1	2	3	4	5	6	7	8
1. LOC	3.83	2.16	—							
2. Concentration	3.23	.78	-.06	—						
3. Perception	3.76	.66	.02	-.24**	—					
4. Listening	3.58	.91	-.13*	-.27**	.30**	—				
5. Abilities	4.08	.79	-.04	-.15*	.32**	.36**	—			
6. Method	3.74	.75	.07	-.14*	.33**	.31*	.20**	—		
7. Reading	3.38	1.08	.18**	-.03	.11	-.17*	.08	-.07	—	
8. Noticing	3.21	1.24	-.02	-.20**	.14*	.14*	.03	-.04	.03	—

*p<.05 **p<.01

Table 3-Comparison of Learning Performance Factors between Gender Groups

Learning factors	n	Mean	SD	t	df	p
Concentration						
Male	153	3.17	.80	-1.51	276	.13(ns.)
Female	125	3.31	.75			
Perception						
Male	153	3.87	.69	3.09	276	.01**
Female	125	3.63	.58			
Listening						
Male	153	3.49	1.00	-2.00	276	.05*
Female	125	3.70	.77			
Abilities						
Male	153	4.04	.85	-.96	276	.34(ns.)
Female	125	4.13	.71			
Method/Imitation						
Male	153	3.67	.79	-1.87	276	.06(ns.)
Female	125	3.83	.70			
Reading						
Male	153	3.47	1.02	1.57	276	.11(ns.)
Female	125	3.27	1.14			
Noticing						
Male	153	3.26	1.23	.94	276	.35(ns.)
Female	125	3.14	1.05			

Students' learning performance was also compared between two age groups. Table 4 lists means, standard deviations of two age groups and t-values and significant levels of mean difference tests. According to Table 4, no significant differences were found between fewer than 20-and over 20- year's age groups.

Hypothesis Testing

It was hypothesized in this study that locus of control will be related to learning performance factors. To test the hypothesis, a series of hierarchical regression analysis were conducted to examine how locus of control predicts learning performance variables in this study. Gender and age are thought to be related to learning factors. To control potential demographic

effects, these two variables were entered into the equation in the first step in each analysis. Then, locus of control was entered into the equation in the second step. Table 5 shows regression analysis results.

Table 4-The comparison of Learning Performance factors between Age Groups

Learning factors	n	Mean	SD	t	df	p
Concentration						
18-20	219	3.20	.80	-1.16	276	.25(ns.)
21-25	59	3.33	.71			
Perception						
18-20	219	3.73	.68	-1.59	276	.11(ns.)
21-25	59	3.88	.56			
Listening						
18-20	219	3.55	.94	-1.32	276	.19(ns.)
21-25	59	3.72	.77			
Abilities						
18-20	219	4.05	.80	-1.51	276	.13(ns.)
21-25	59	4.22	.74			
Method/Imitation						
18-20	219	3.74	.79	-.15	276	.88(ns.)
21-25	59	3.75	.63			
Reading						
18-20	219	3.34	1.10	-1.09	276	.28(ns.)
21-25	59	3.52	1.01			
Noticing						
18-20	219	3.17	1.11	-1.01	276	.32(ns.)
21-25	59	3.34	1.21			

It can be seen in Table 5 that gender showed no significant association with learning performance factors. Student age was found to have a significant positive influence on perception factor and negative influence on method/imitation factor. These findings imply that younger participants use more imitation as their means of learning than older ones whereas older students showed better understanding and perception in their learning performance than younger ones. Age showed no significant influence on other learning performance factors.

The results also revealed that internal locus of control had significant positive influence on reading ($\beta = .164$, $p < .01$) and negative influence on listening ($\beta = -.121$, $p < .05$). No significant associations were found between locus of control and other learning performance dimensions. Thus, the findings provided partial support the hypothesis proposed in this study.

Discussion

The purpose of this study was to examine what influences of the locus of control has on the learning performance of university students. Myanmar adaptations of Internal-External Locus of Control Scale and Learning Scale were used to tap levels of locus of control and seven dimensions of learning performance among university students.

Table 5- Learning Factors Regressed on Locus of Control

Variable	F	df	adjusted R^2	β
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Concentration	.96	3,274	.00	
Gender				.005
Age				-.085
Locus of control				-.048
Perception	3.90**	3,274	.03	
Gender				.087
Age				.181**
Locus of control				-.009
Listening	3.59*	3,274	.03	
Gender				.103
Age				-.109
Locus of control				-.121*
Abilities	2.00	3,274	.005	
Gender				.107
Age				-.057
Locus of control				-.043
Method/Imitation	1.93	3,274	.01	
Gender				.032
Age				-.122*
Locus of control				.084
Reading	4.14*	3,274	.03	
Gender				.045
Age				.075
Locus of control				.164**
Noticing	.38	3,274	.00	
Gender				.002
Age				.060
Locus of control				-.031

It was hypothesized in this study that locus of control will be related to learning performance factors. This hypothesis was tested by using a set of hierarchical regressions. It was found out that gender showed no significant association with learning performance factors. Student age was found to have a significant positive influence on perception factor and negative influence on method/imitation factor. These findings imply that younger participants use more imitation as their means of learning than older ones whereas older students showed better understanding and perception in their learning performance than younger ones. Age showed no significant influence on other learning performance factors.

The results of this study revealed that internal locus of control had significant positive influence on reading and negative influence on listening. No significant associations were found

between locus of control and other learning performance dimensions. Thus, the findings provided partial support the hypothesis proposed in this study.

In the study done by Kutanís, Mescí and Övdür (2011), it was found that locus of control has a vital influence on method, ability, and noticing factors of the learning dimensions. In the study conducted by Basım and Sesen (2006), individuals with internal locus of control had more tendencies to help and perform courteous attitudes when compared with the ones with external locus of control. Chen and Silverthorne (2008) have also found that these qualities of the individuals with internal locus of control have considerable impact upon work performance and content levels. In contrast to findings from these previous studies, locus of control had only positive impact on reading in this study. There may be two reasons for the insignificant findings of the influence of locus of control on learning performance dimensions in this study.

First, most of the participants in prior studies conducted in other countries were identified as internals and the samples used in these studies were heterogeneous. In contrast, this study used a homogeneous sample of Dagon University students and their scores of internal locus of control were found to be relatively low. The findings from the present study suggested that internals have a tendency to engage in reading activities in their learning. In addition, internals, particularly university students, were less likely to engage in passive listening and reading aloud.

Second, the original items from some learning dimensions including noticing, method, and concentration are more appropriate for high school level students. In this study, learning performance scales were adapted scales which may not be entirely relevant for Myanmar cultural and educational settings.

The results of this study revealed that there were some differences in learning performance between gender groups. Male students were significantly higher in perception/understanding factor than females. In contrast, female students were found to be significantly higher in listening factor than males. There were no significant differences between males and females in concentration, abilities, method, reading, and noticing factors. In the study conducted by Kutanís, Mescí and Övdür (2011), it has been found that there is difference in some learning performance dimensions between student gender groups.

Students' learning performance was also compared between two age groups. No significant differences were revealed between aged 18 to 20 years and over 20- years' age groups. Lack of difference between learning dimensions between age groups might be due to the fact that the sample used in this study was homogeneous and nearly 80% of participants were between the ages of 18-20 years.

Conclusion and Recommendations

Conclusion

Locus of control focuses on ability to cope with uncertainty. While the individuals who have less tolerance resist to the change, the ones with high tolerance can adapt to the change more easily. Therefore, locus of control tries to identify the reaction given to change according to its status. If an individual can make self-control and has the belief that he/she is the dominant of his/her fate, he/she can give positive reactions to the change. Individuals are classified in two groups according to locus of control. The first group is internals, and the other is externals. The individuals with internal locus of control have the belief that they can monitor the events or situations with their own fate and they have a strong belief in themselves and their abilities in life. They believe that the reactions that they take from environment are the causes of their attitudes. On the other hand, the individuals with external locus of control relate the events and situations,

success or failures to the factors not related to them. For example, they attribute success to backing; however, they base failure upon environmental factors (Kutanis, 2010; Sargut, 2001).

According to the findings from this study, the following conclusions have been drawn:

1. Locus of control had significant impact on some dimensions of learning performance:

(a) Internal locus of control had significant positive influence on reading factor of learning performance.

(b) Internal locus of control had significant negative influence on listening factor of learning performance.

2. There were significant differences in some dimensions of learning performance among demographic groups:

(a) Male students were significantly higher in perception/understanding dimension of learning performance than females.

(b) Female students were significantly higher in listening dimension of learning performance than males.

Recommendations

Based on the empirical findings from this study, the following recommendations were offered:

1. The concept of locus of control can be applied to teaching and learning process and higher levels of internal locus of control have a link with higher learning outcomes. Therefore, university teachers should use student-oriented teaching methods that promote student internal locus of control.

2. Since the present study only focus on learning performance of university students, future research that will provide more insight into dimensions of learning performance of both Myanmar high school and university students should be carried out.

3. In this study, measurement issues on the locus of control and learning performance were beyond the scope of this study. Thus, further research should also be focused on measurement properties of the scales used in this study.

4. Locus of control is a vital factor for students' academic success, extensive research on the antecedents and correlates of locus of control in Myanmar educational setting should also be needed.

Limitations of the Study

The major limitations of this study should be acknowledged when interpreting the findings from the study. The present study only relied on quantitative questionnaire survey and used a convenient sample which included only students from Dagon University. In addition, some items from LOC scale and learning scales were dropped because of poor item quality. Therefore, the generalizability of findings is limited.

Acknowledgements

I would like to express sincere gratitude and thanks to Rector Dr Nay Win Oo, Pro- Rectors Dr Aye Aye Ko, Dr Wah Wah Lwin, and Dr Thida Aung from East Yangon University for their kind permission to publish this research.

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RIGHTS OF CHILD OFFENDER IN MYANMAR

Zune Yupar Myint¹, San San Lwin²

Abstract

This research is mainly focused on the juvenile offenders to enjoy full rights during their detention periods. Generally, it is difficult to provide full rights for juvenile offenders. Myanmar ratified and signed on the Convention on the Rights of the Child in 1991 to follow the rights of Juveniles. After that Myanmar new Child Rights Law include the rights of the juveniles. According to the Child Rights Law, every child has the right whether they commit a crime or not. Therefore, the juvenile offender who have detaining in the training school should have the right under the Child Rights Law. Even though the new Child Right Law is good for the children but it still needs to be implemented to become more useful in practice. According to the interviews, children need to facilitate regarding with the physically or mentally to enter into the community. Therefore, training schools are the main place to provide that sorts of needs for the child offenders who have been detaining there.

Keywords; child right, child offender, training school, rehabilitation, reintegration

Introduction

In the juvenile justice system under child law for child offenders around the world prohibits harsh punishment and puts the best interests of the child first. It has been recognized that children and youth are a major human resource. Human rights are the rights that a person has because he is a human being. Children should have the same opportunity to protect themselves. A child offender is a child who has been convicted for a criminal offence. Even during the punishment, there should be a chance for the child to change the life style both physically and mentally. Child offender also called children in conflict with the law. Rehabilitation should focus on balancing the needs of child offender and society. The mindset of child offenders must also be changed. By transforming them like this, they will become human resources that will benefit for the country. The purpose of punishment is important. The main purpose of the punishment is to protect the society by preventing the offenders, to prevent the offenders from committing crimes again and to become law-abiding citizens. Just providing sentence as a punishment to the child who committed the crime does not mean that the essence of the law can be fully implemented. Rehabilitation of child offenders must be considered by the court. The purpose of rehabilitation is to change a person's thoughts and actions. Correcting the offenders so that they can avoid wrongdoing in the future protects the community. The offenders can become good citizens in the community by forgiving their mistakes and following the law, even if they have committed crimes in the past. Therefore, the rehabilitation period is very important for child offender. Leaders of the country have come together to protect and fulfill the rights of the children by obeying the convention on the rights of the children around the world. The CRC sets out the government's responsibilities to ensure the rights of the child. Ratified to the CRC have the legal obligation to do so in their own country.

Directly related to the question of non-criminalization of victims is the obligation incumbent on States parties to take measures to ensure appropriate assistance to child victims, including their full social reintegration and their physical and psychological recovery.³ Therefore

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³ General assembly, report of the committee on the Rights of the Child, sixty-third session supplement No41, United Nations New York, 2008, p.

the State has the responsibility to uphold the rights of child offender. To analyze how the successful reintegration of children in conflict with the law implement into the society during the rehabilitation period.

This research focuses on getting the child offender back into society as a good person, according to Child Rights Law 2019 in Myanmar. In addition, this research did the comparative study with article 40 of the Convention on the Rights of the Child. Children accused of violating the law should have the right to legal assistance. Punishment should focus on enhancing their dignity, family reunification and reintegration in society.

Research Question

1. How are the children who are in conflict with the law reintegrated into the society during rehabilitation period?

Research Design and Research Methodology

This research used qualitative research. In data collection, primary and secondary data were used. In order to gather secondary data, resources from research paper, relevant articles, academic journals and legislation text books as well as legal documents, mainly CRC, 2019 Child Right law in Myanmar, 1993 Child law in Myanmar.

For primary data, telephone interview, face-face interview and Key Information Interview (KII) were used. Qualitative research is a type that involves collecting and analyzing data without statistical methods to understand concepts, opinions, or experiences as it stands. It can be used to gather in-depth insights into a problem or generate new ideas.⁴

Target Population and Sample Size

The focus of this study was on the rights of child offenders of ten training schools on child offender in Myanmar Ngeek Aw San Youth training schools, Kawhmu Township, was chosen to visit because it is a place where children who commit crimes are detained to serve their sentences. There are 10 training school in Myanmar under the Department of Social Welfare. Among them, three are for girls and four are for children in need of protection. Only the other three training schools accept young boy convicted of crimes and convictions. Of the three training schools, Ngeek Aw San Youth training school is the largest. There were about 7 participants such as lawyers, judges, officials from training school and NGO officials working to promote child rights and the information of the participants are mentioned in following table. When selection of sample, purposive sampling was used as researcher can judge participants to be interviewed for the study. During the interview, three people were interviewed over the phone and four were interviewed face to face. Each interview took about an hour and a half. When asking interview questions, ask open type questions. After the interview, the data was analyzed.

Sr no	code	occupation	gender	age
1	B1	Inservice, Ngeek Aw San Youth training schools	Male	50
2	B2	NGO	Male	54
3	B3	Lawyer	Female	60
4	B4	lawyer	Female	38
5	B5	Judge Juvenile court in Yangon	Female	55
6	B6	retired	Male	61
7	B7	Retired Ngeek Aw San Youth training schools	Male	73

⁴ Pritha Bhandari, What is qualitative research dissertation? published on June 19,2020

Laws relating to child offender

The rights of the child are also a human rights issue. After World War –II, the United Nations General Assembly accepted the Declaration on the Rights of the Child. This declaration became official in 1989 as the Convention on the Rights of the Child to protect the rights of the child.

The Convention on the Rights of the Child is the first international agreement on the protection of child rights. According to Article 3 of the Convention on the Rights of the Child specifies that the interests of children should be concerned in the affairs of the children. A child means every human being below the age of eighteen years unless under the law applicable to the child majority is attained earlier.⁵

The CRC was adopted by the General Assembly of the United Nations on 20 November 1989, and it gone into power on 2 September 1990. Myanmar has accepted the convention on 16 July 1991 and it became a member country of the Convention on 14 August 1991. To implement the child rights contained in the CRC, the Child Law was proclaimed on 14 July, 1993. The provisions of the 2019 child law were inconsistent with the CRC. Therefore, The Government of Myanmar abolished child law 1993 and enacted Child Rights Law 2019 to implement the rights of children in the Convention on the Rights of the Child.

According to the Majority Act section 3, a person shall be deemed to have attained his majority when he shall have completed his age of 18 years and not before.⁶ Therefore, in the Majority Act of Myanmar, a person under the age of 18 is considered a minor.

Every child laws aim to protect the best interests of the children. It is also possible for a child offender to be rehabilitated and reintegrated into the community.

Most of the laws have the exception to the Act of a child who is at the minimum age prescribed by relevant law.

At Article 40 (3) of the Convention on the Rights of the Child, member states must adopt law and procedure, the age of the child should be determined and the crime committed should be considered.⁷

Under the current criminal law in Myanmar, the age limit for children who can be exempt from crime is as follows. According to section 82 of the Criminal Law in Myanmar, nothing is an offence which is done by a child under seven years of age.⁸ Under section 83 of the Criminal Law in Myanmar, nothing is an offence which is done by a child above seven years age and under twelve, who has not attained sufficient maturity of understanding to judge of the nature and consequences of his conduct on the occasion.⁹

According to Section 78 of the Child Rights Law 2019, (a) Nothing is an offence which is done by a child under 10 years of age; (b) Nothing is an offence which is done by a child above 10 years of age and under 12, who has not attained sufficient maturity of understanding to judge of the nature and consequences of his conduct on that occasion.¹⁰

⁵ Article 1 of CRC

⁶ Section 3 of the Majority Act

⁷ Article 40(3) of CRC

⁸ Section 82 of the Penal Code, 1861

⁹ Section 83 of the Penal Code, 1861

¹⁰ Section 78 of the Child Rights Law

Under 1993 Child Law in Myanmar, it is stipulated that a child under the age of 7 and a child between the ages of 7 and 12, do not know the consequences of the crime and the consequences of their crime are not guilty.

In Criminal Law and 1993 Child Law, the age of the child who is exempt is the same. Child Rights Law was amended in 2019 in accordance with CRC. Because of, the age of the child is different Criminal Law and Child Right Law. There is a difference between the exempt life of a child who committed the offence under Penal Code and Child Rights Law. But, the sentence for acquittal of a child is generally defined as under 12 years of age.

Even though Myanmar new Child Rights Law defined the age of the child from seven to ten years regarding the liability but it still does not meet the international guide line set by the Child Right Convention. Children should be acted as a final course of action and they are also should be carried out with diversion. At the moment, one of the challenges is that, the authority still detains the children and except to trial but the effective trial on the child is still restricted. So, the procedure, exercising diversion and alternative sentencing, still necessary to run effectively.¹¹ In 1993 Child Law in Myanmar, a person under the age of 16 is considered a child and a person between the age of 16 and 18 is considered a youth. Now Child Rights Law has abolished the term youth and defined a person under the age of 18 as a child.

During the trial, a child who has reached the age of 18 must be re-examined as a child under the age of 20. Punishment shall be imposed in accordance with child right law as a child.¹² According to the case of the Government of the Union of Myanmar V U Tun Kyaing, children under 12 can commit rape because in the tropics, children are adults early. The defendant was convicted of attempted rape of a child under 12 years of age.¹³ In Myanmar, the government prosecutes perpetrators in criminal cases.

In different countries, the age of children exempt from crime has been varied. Children under this age are not responsible for the criminal justice. In Singapore, 1993 Children and Young person Act, which is relevant to juvenile justice, under the age of 14 years define as a child.

In its General Comment 19, the UNCRC 1989 recommended 12 years old as the acceptable minimum age of penal infringement and deplored countries that placed the minimum age of criminal responsibility lower than this because the UNCRC found it unacceptable by international standards. The Committee has urged State Parties to increase the minimum age to the preferable age of 18 years old, and has duly justified this stance by recognizing the developmental differences and decision-making capabilities of children and youth.

Juvenile Justice System in Myanmar

Juvenile justice system is a legal system for juvenile offenders between the age of 10 and 18. Children who commit crimes in the juvenile justice system are brought before juvenile court which is separate from common judicial court. Child cases must be heard early. NO one shall be present at the hearing except the person authorized by the court. Children can be provided with interpreters if needed and a suitable person who may be allowed to defend on behalf of the child.¹⁴

According to Criminal law of Myanmar, whoever, intending to take dishonestly any moveable property out of the possession of any person without the persons consent, moves that property in order to such taking is said to commit theft.¹⁵

¹¹ <https://reliefweb.int/report/Myanmar.international-legal-foundation-and-unicef-myanmar-join-forces-protect-children>

¹² Section 86 of the Child Rights Law

¹³ 1918 AIR lower burma p.96

¹⁴ Section 85 of the Child Rights Law

¹⁵ Section 378 of the Penal Code,1861

Maung Zaw Thein Htike, a 16 years old at Ngek Aw San Youth Training School, was charged with theft. His cousin told him that he would pay for some money if when go with him to steal a motorcycle. So he went with his brother to steal a motorcycle. The patrol arrived when he found the stolen motorcycle and then he was arrested. The court ordered him to stay at the youth training school for two years.¹⁶

Maung Zaw Thein Htike approached the motorcycle with the intention of taking it. But, he was arrested before he stole the motorcycle. Punishment of a child who has not yet committed a crime is not appropriate for a child.

Once the children are arrested, they need skilled defenders who can stand up for the children who can deal with child cases. It is very important to have the right protections and a fair trial in juvenile justice. The best interests of the child must be considered when investigating a child case.

According to section 82 of the Child Rights Law, the Supreme Court may establish juvenile courts in appropriate local areas and appoint juvenile judges and in local areas where juvenile courts under sub-section (a) have not been established confer powers of a juvenile judge on a Township Judge.¹⁷

The Supreme Court has established two special Juvenile courts for Yangon City area which includes 20 townships, and for Mandalay City area including 5 townships. The Supreme Court has also appointed Juvenile Judges. In all other areas of the country, where have not been established juvenile courts, the presiding judge of the township court is empowered to serve as the juvenile judge.¹⁸

The best interests of the child must be considered when investigating a child case. Under section 85 of Child Rights Law, child case must be heard early. No one shall be present at the hearing except the person authorized by the court. Children can be provided with interpreters if needed and suitable person who may be allowed to defend on behalf of the child.¹⁹

If the child is not committing a serious crime, he will be disciplined and released. If the child reaches the age of 14 and has income, the child can be fined, and if there is no income, the parent or guardian can be fined. In order to prevent recurrence, the child can be placed with the parent or guardian for no more than three years. A child who cannot be cared for by a parent or guardian must be sent to training school.²⁰In many countries, compensation for juvenile delinquency is allowed for the benefit of the child.

According to section 83 of the Child Rights Law, the juvenile court shall only convict children under 18 years of age at the time of the offence. The juvenile court must be start to proceeding for the child who committed the offence which may be suffer 3 years imprisonment or death penalty, in the manner in which a warrant case is tried.²¹

There are two trials for Juvenile cases. They are summon trial and the warrant trial. If juvenile offences are punishable with imprisonment for a term not exceeding 3 years, the court shall try the case in summon trial. If juvenile offences are punishable with death, transportation for life or imprisonment for a term exceeding 3 years, the court shall try the case in warrant trial.²²

¹⁶ SanYamin Aung, A brighter future for Burma Juvenile offender, published on 13 may 2017, <https://burma.irrawaddy.com/article/2017/05/13/134758.html>

¹⁷ Section 82 of the Child Rights Law

¹⁸ <http://www.apcjj.org/sites/default/files/paper.pdf>

¹⁹ Section 85 of the Child Rights Law

²⁰ Section 89 of the Child Rights Law

²¹ Section 83 of the Child Rights Law

²² <http://www.apcjj.org/sites/default/files/paper.pdf>

The international community has ratified human rights treaties around the world and child offenders are permanently removed from the death penalty in some countries where human rights are practiced. Several international humanitarian law treaties also prohibit the use of the death penalty. Child Rights Law 2019 also removed the death penalty to child offender.

Article 37 (a) of the Convention on the Rights of the Child state that neither capital punishment nor life imprisonment without possibility of release shall be imposed for offences committed by persons below 18 years of age.²³

To rephrase the UN, CRC, Child Rights Law in Myanmar prohibited, notwithstanding anything contained in any existing Law, a sentence of death, transportation for life, indefinitely imprisonment and a sentence of twenty years shall not be passed on the children.²⁴

In Myanmar, there is a high rate of crime due to lack of funds to promote after-care facilities and to create more infrastructure, which implies that the treatment process is not sustained. Discrimination by society after juveniles are released from correctional facilities such as training schools makes them feel unwanted; thus, they opt to reoffend. This is compounded by inadequate human resource capacity, especially social workers.²⁵

A child does not yet have the ability to rational thinking. In many countries of the world, their crimes are prosecuted according to specific rules for children. Prevention must be carried out in strictly accordance with the law.

Treatment of Child Offender

According to Article 40 (1) of the CRC, States Parties recognize the right of every child alleged as, accused of, or recognized as having infringed the penal law to be treated in a manner consistent with the promotion of the child's sense of dignity and worth, which reinforces the child's respect for the human rights and fundamental freedoms of others and which takes into account the child's age and the desirability of promoting the child's reintegration and the child's assuming a constructive role in society.²⁶

The principles consist of:

- Treatment that is consistent with the child's sense of dignity and worth;
- Treatment that reinforces the child's respect for the human rights and freedom of others;
- Treatment that takes into account the child's age and promotes the child's reintegration and the child's assuming a constructive role in society.

According to section 89 (e) of Child Rights Law in Myanmar, in any offences if the child is of a perverted but has no parents or guardian or it the child has parents or guardian but cannot be admonished and is in no circumstances for custody and care, may commit such child to the custody of any training school for a minimum term of 2 years or till he attains the age of 18 years or 20 years as a maximum term.²⁷

Juvenile training schools are judicial institutions under the jurisdiction of the Ministry of Justice that provide corrective education and reintegration support for the purpose of fostering the sound cultivation of juveniles sent as a protective measure by family courts.²⁸

For children who have committed a crime, the training school is a place where they are taught for requirements for starting a new life when they return from training school.

²³ Article 37(a) of CRC

²⁴ Section 88(b) of the Child Rights Law

²⁵ https://www.unafei.or.jp/publications/pdf/RS_No102/No102_18_GW_Group_2.pdf

²⁶ article 40(1) of CRC

²⁷ Section 89(e) of the Child Rights Law

²⁸ http://www.moj.go.jp/EN/kyousei1/kyousei_kyouse04.html

According to the Young Offender Act 1930, the Combine Borstal and Senior Training School was opened in Thayetmyo in 1931 to correct young offender. The school was transferred by the Ministry of Social Welfare on 1974 and Hnget Aw San Youth Rehabilitation Center Youth Training Center in Kawhmu Township, Yangon, opened in 1975.

In section 93 of child right law stated that custody and care of children and youths in prison. It might be mention that, not keep him together with adult prisoner until he attains the age of 18 years and to provide medical checkups regularly for child offender. Furthermore, the officer in charge of a prison shall train and give him education which will reform his physical, mental, character and vocational educations.²⁹

Child offenders need to be physically and emotionally treated. Every child offender shall have the rights of treatment, no corporal punishment, Separation from adult criminals, if detained, Access to legal assistance and so on.

In such treatment, counseling and vocational training should be provided in consultation with psychiatrists. Reintegration to society by encouraging a sense of humility can help prevent future crime. Poverty makes children more likely to commit crimes. Therefore, it is necessary to help solve the problems of children's living environment. It is important to prevent child problems. A child can be lost if the children are not well cared for during the rehabilitation period. If so, the child may not be a good citizen. Then we will lose a good citizen for the country.

Findings

Health of the children in the training school shows that the number of children in the training school and the lack of staffs that are proving health are still poor. Children are discriminated in the high school because they are coming from the training school. Children do not have access to best education in training school. Education is a struggle for the child offender. It is important to educate children in training school. Vocational skills are taught to children who have difficulty getting an education. Vocational training is very important for children to be able to apply the vocational skills in their community. Society also has a great role to play in ensuring that children who have been to school are able to fit into the community. The Child Right Law provides for every child to have access to basic necessities such as education, health, and justice for the safety of children and so on. Therefore, it is necessary to enact more comprehensive Child Rights Law which guarantee the rights of child offender. It also needs to be effective implementation of the Child Rights Law.

Conclusion

Children who have committed crimes are entitled to the rights enshrined in the law, as they are included in the term of juvenile. When it comes to child justice, Child Rights Law 2019 has been accused of separating children from adult criminals. In practice, the purpose of the law has not been fully realized. There is not enough space to detain the accused children. However, there are weaknesses in the study of rehabilitating for child offenders. In addition to education and vocational training, English language, culture and arts courses should also be offered. Vocational education is one of the main priorities of training schools. However, there are weaknesses in opening all the required courses. They need to have the resources for the vocational training such as expert and teaching material for practicing and of course funding is also necessary. While vocational training is based on the child's interests, it is also important to choose subjects that are

²⁹ Section 93 of the Child Rights Law

appropriate for the child's environment. Skilled health workers need to be recruited according to the number of children in the training school. Most of the children who come to school come because of theft. Children often develop bad habits because of their environmental factors and family problems. Children who come to the training school need to be treated primarily their psychological problems. It is very important for children to be able to return to society with integrity. Every family and the whole societies have a responsibility to make children good citizens. There is still a lack of surveillance for children who is leaving the school. It still needs to be implemented in terms of raising children for the future.

Acknowledgements

I would like to extend my heartfelt thanks to Rector, Dr. Nay Win Oo, Dr., Pro-Rectors Aye Aye Ko, Dr. Wah Wah Lwin and Dr., Thidar Aung of East Yangon University for their encouragement to do this research. I cannot express enough thanks to my Professor Dr Thi Thi Lwin, Head of Department of Law, East Yangon University, for her kindly permission to carry out this research and Professor Dr San San Lwin, Department of Law, East Yangon University, for her warmly discussion to complete this research. I would like to thank everyone who help me in gathering information, collecting data and guiding me from time to time in making this project.

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THE ROLE OF MYANMAR IN COMMIT DURING 2004-2018

Htay Htay Nyein*

Abstract

Trafficking in Person is the act of illegal trading of human beings as goods for the purpose of exploiting a person with or without his or her consent. The problem of trafficking in person is now rampant through the world. Mekong basin is the place where the number of cases of trafficking in person is the highest in Asia. The Coordinated Mekong Ministerial Initiative against Trafficking (COMMIT) seeks to provide the basis for a strengthened regional multi-sectoral response to trafficking in the Greater Mekong Sub-region. The initiative which began in November 2003 with a Preliminary Round Table Discussion by governments of the GMS is a concerted sub-regional specific approach to combat human trafficking –an increasing menace to human security in the region and in the world. Human trafficking is a complex issue that has deeply rooted reasons under the background of economic, social, and cultural development. The fight against and prevention of trafficking is a long term and arduous task, which needs close collaborations and cooperation with many departments, institutions concerned and multi-level support and even countries in the region. It needs to be dealt with in a comprehensive manner by way of laws, administrative regulations and through the means of economy and education.

Key words: COMMIT, human trafficking, cooperation,

Introduction

Human trafficking is a form of slavery that has existed in the world for hundreds of years. It is a problem that reemerged in the latter part of the twentieth century as a form of modern slavery. Trafficking in person is the act of trading human beings as goods, including torturing, prostituting and exploiting them for profit, negatively affecting a person not only physically, but also affecting their dignity and psycho-social condition. Nowadays trafficking in persons has become one of the most challenging issues for many countries. Unlike other common crimes, the problem of human trafficking is a complex issue closely entwined with political, economic, social and developmental issues, including the effects of poverty, natural disasters and trans-boundary issues. Thus, in spite of the considerable preventive efforts exerted by countries around the world to combat human trafficking, the international community has to recognize that the problem is growing. With the aim to eliminate and combat all forms of exploitation committed against fellow humans without exception, in 2000 the United Nations General Assembly adopted the United Nations Convention against Transnational Organized Crime together with a number of protocols relating to human trafficking and human smuggling.

Myanmar's Participation in COMMIT to Combat Human Trafficking

Myanmar considers all acts of human trafficking to be criminal and has initiated preventive measures as a national cause since 1997. In 2002 Myanmar has participated in the Conference on Combating Trafficking in Persons for the Asia Pacific countries that was co-chaired by Australia and Indonesia to implement the Bali Process and has actively cooperated in this Bali Process. In order to protect women and children from being trafficked, Myanmar Women's Affairs Federation (MWAF) was formed on 20 December 2003. MWAF is working to combat trafficking in persons with the cooperation of UNIAP and other UN agencies, INGOs and NGOs. Myanmar also signed a MoU with the Australian government to implement the "Asia Regional Cooperation to Prevent

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People Trafficking Project” which includes Myanmar, Thailand, Cambodia and Laos PDR on 22 December 2003. Myanmar’s government has undertaken a number of initiatives to combat human trafficking. The Union of Myanmar has become a member of United Nations Convention on Transnational Organized Crime (UNTOC) and the Protocol to Prevent, Suppress and Punish Trafficking in Persons, especially Women and Children, and Protocol against the Smuggling of Migrants by Land, Air and Sea on 30 March 2004 and is carrying out anti-human trafficking measures according to the Protocols. In this Convention, Mutual Legal Assistance (MLA) and Extradition are important provisions for the state parties. To be in line with and to implement the provision of MLA, Myanmar enacted Mutual Assistance in Criminal Matters Law on 28 April 2004 and Mutual Assistance in Criminal Matters Rules on 14 October 2004.

The Coordinated Mekong Ministerial Initiative against Trafficking (COMMIT) process was officially launched, with the cooperation of UNIAP on 29 October 2004, when the COMMIT MoU was signed by the ministers from 6 GMS countries (China, Myanmar, Laos, Thailand, Vietnam and Cambodia). The COMMIT seeks to provide the basis for a strengthened regional multi-sectoral response to trafficking in the Greater Mekong Sub-region (GMS). In broad terms, the objectives of the COMMIT process are:

- 1.To promote and strengthen systems and arrangements of inter-country and regional cooperation against human trafficking;
- 2.To establish a holistic regional response, covering all aspects of the trafficking problem and ensuring that concern for the victim is at the centre of all interventions;
- 3.To identify and adapt successful models in one country to others as appropriate; and
- 4.To enhance national capacities to address human trafficking in order to facilitate each country’s engagement at the sub-regional level, building on existing strengths in each country

The COMMIT process is being supported by UNODC, in cooperation with the Asian Development Bank (ADB), Norwegian Government, New Zealand Agency for International Development, Swedish International Cooperation Agency, United Nations Development Programme, United Nations Population Fund, United Nations Children Fund, Save the Children UK and International Organization for Migration. In order to move towards the commitments made under the MOU, the COMMIT countries adopted Sub-Regional Plan of Action which at the third Senior Official meeting held in Hanoi, Vietnam in March 2005. The State Peace and Development Council enacted the Anti –Trafficking in Persons Law on 13th September, 2005. In order to implement the Anti-Trafficking in Persons Law effectively, a Central Body was formed on 11 February 2006 and Working Group on Prevention on Trafficking in Persons and Protection of Trafficked Victims, Working Group on Legal Framework and Prosecuting Measures and Working Group on Repatriation, Reintegration and Rehabilitation of Trafficked Victims were established at various levels on 27 February 2006. The national seminar on Anti-Trafficking in Persons Law was organized by MOHA and UNIAP in Yangon On 28 February and 1 March 2006. The objectives of the seminar were to enhance the awareness of the public and responsible persons regarding this law and to have effective cooperation among criminal justice sectors, government departments, NGOs and civil society. Similar kinds of workshops were conducted at major cities of the states and divisions. Myawaddy receiving Centre was established on 18 February 2002 to receive illegal migrants who are lured by brokers or who migrated voluntarily for various reasons but have faced various difficulties and want to return back home. Since the establishment of the centre up to December 2007, 24508 persons (17967 males, 6522 female and 19 children) were received and returned back to their families.

During the period of 2006 to 2007, 18 Anti-Trafficking Task Forces (ATTFs) were formed and assigned in Yangon, Mandalay, Bhamo, Kalembo, Muse, Tachileik, Myawaddy, Mawlamyine, Kawthoung, Myitkyina, Kyaing Tong, Taunggyi, Lashio, Myeik, Meikhtila, Magwe, Maung Taw and Bago. Anti-Trafficking Unit (ATU) was formed by Ministry of Home Affairs (MOHA) with 40 police officers in June 2004 who received trainings under the ARCPPT project. The Unit has also received training on investigative techniques as well as on human trafficking issue. It was one of the first countries in the region to establish a specialist anti-trafficking police unit, which is widely regarded as best practice, and has passed a 5-year National Plan of Action (NPA) in areas like prevention, law enforcement and protection. In March 2005, the Department against Transnational Crime (DTC) was established with 99 members of police officers and ranks. Myanmar was also the first country in the Mekong region to pass a comprehensive anti-human trafficking law in line with the international standards and defined by the Palermo Protocol.

In 2007, Myanmar and China signed their first Bilateral Memorandum of Understanding on human trafficking. The two countries cemented this agreement with the unveiling of the first Border Liaison Office (BLO) in Ruili City, located in China's southwestern Yunnan Province-one of the primary crossing points between China and Myanmar. To prevent cross-border human trafficking between Myanmar and China, the BLOs in Muse and Ruili were established on 12 July 2007 and Loiye and Zhang Feng Border Liaison Offices were established on 22 December 2008. Since the establishment of the BLOs, monthly meetings have been conducted with the aim of strengthening cooperation between the two countries. In order to move toward the commitments made under the MOU, the sixth meeting of the COMMIT Senior Official Meeting was held on 5 November 2008 and 6 November 2008 in Vientiane, Laos and Myanmar delegation led by Chief of Police General Staff of the Myanmar Police Force attended the meeting. At the meeting, the implementation of the 2008 COMMIT Sub-regional Plan of Action was reviewed and the future plan of action was adopted with the strong emphasis on cooperation and linkages between policy and practices. During 2009, COMMIT Task Force meetings were conducted 5 times. The meetings were attended by participants from the 18 relevant departments, UN partner agencies, international organizations and local NGOs. In these meetings the implementation of current and future activities were discussed. The milestones of 2009 that marked historic achievements in Myanmar included the signing of the memorandum of understanding on human trafficking with China and Thailand. In 2009, a total of kyat 4101 million (US\$ 4.1 million) was spent by government departments and local NGOs on countering efforts as compared to 2008 spending totaling K 2863 million (US\$2.86). This shows a clear increase in financial commitment to anti-trafficking initiatives in Myanmar.

Myanmar hosted the Seventh COMMIT Senior Officials Meeting in 2010 from 20 to 22 January in Bagan. This Meeting provides an opportunity to look at the impact that the COMMIT Process is having on the lives of real people and brings together over 135 participants from the six governments in the Mekong region and observers from other ASEAN countries, the UN, INGOs and donors. The purpose is to reaffirm their commitment to eradicating all forms of human trafficking in the region, share and evaluate progress in 2009 and lay the foundations for future strengthened cooperation in counter trafficking. In order to implement the Anti-Trafficking in Persons Law effectively, the Central Body for Suppression of Trafficking in Persons was reformed on 27 May 2011. Myanmar attended the COMMIT Meetings of the six Greater Mekong Sub-region countries held on 25-27 May 2011 and 13-14 October 2011, respectively, in Bangkok, Thailand; shared information and experiences and observed best practices of other countries in the

region. In addition, the Third COMMIT Sub-regional Plan of Action (2011-2013) was reflected in the Second Five-Year National Plan of Action (2012-2016). To jointly combat transnational crime including human trafficking, the ministerial meetings were held with China and Laos. The Myanmar – China Ministerial Meeting was held at the Myanmar Convention Centre, Nay Pyi Taw, on 6 June 2011 and attended by the Myanmar delegation led by Deputy Minister of the Ministry of Home Affairs and the Chinese delegation led by Deputy Minister of the Ministry of Public Security. Meeting participants discussed issues concerning the suppression of transnational crime and the stability of the border areas. The Stakeholders Meeting for Suppression of Trafficking in Persons was held in Yangon on 23 June 2011. This meeting discussed the five components in the First Five Year National Plan of Action to Combat Human Trafficking (2007-2011) and recommended prioritization of the areas in the Second Five-Year National Plan of Action to Combat Human Trafficking (2012-2016). The third Inter-Ministerial Meeting (IMM-3) of the Mekong sub-regional countries on fighting human trafficking took place in Hanoi on 16 February 2012. Participants at the event approved an action plan for the 2012-2013 periods.

To support the progress of the COMMIT process and implementation of the third Sub-regional Plan of Action through the work-planning process, the Regional COMMIT Task Force meetings were held. Myanmar attended COMMIT Regional Workshop on Criminal Justice Cooperation on Trafficking in Persons hosted by Cambodia COMMIT Task Force from 11 to 14 January 2012, exchanged information and experiences and took note of the best practices from countries within the region. The Myanmar delegation attended the Regional COMMIT Task Force meetings that were held on 31 January 2012 and from 17 to 20 July 2012 in Bangkok, Thailand. COMMIT Task Force meetings were also held on 4 May, on 4-5 July and on 27 December in Naypyitaw. Myanmar discussed the 2013 work plan in detail and decided to launch media campaigns for educating the public effectively during 2013. Offices for Border Cooperation against Trafficking in Person (BCATIP) have been established between Tachileik and Mae Sai on 22 March 2012 and between Kawthaung and Ranong on 30 August 2012 respectively to effectively combat human trafficking incidences along Myanmar-Thai border. Myanmar implemented (104) COMMIT activities during 2012, ranking the country as one that can implement most activities among 6 COMMIT countries.

In addition, the government more than doubled its budget allocation for anti- trafficking work, with MMK 12.042.358 million (USD 11.6 million) being provided from 2011- 2014 for anti-trafficking work. In 2013, a re-structuring saw the creation of the Anti-Trafficking in Persons Division (ATIPD), an upgrade from the previous Anti-Trafficking in Persons Unit (ATU) with an expanded mandate and increased resources. Comprehensive regional and national training programmes were developed for national anti- trafficking responders and policy makers in Myanmar, with 1109 government officials and NGOs receiving training. From 2011-2014, government officials and NGOs participated in 18 meetings, 3 workshops and 8 training programmes at the regional level as well as 10 meetings, 3 workshops and 37 training programmes at the national level. Following these regional and national COMMIT trainings and sensitizations, including visits to migrant communities in Thailand, officials changed policies and attitudes to human trafficking and safe migration. Further, through cross-border cooperation with Thailand, officials visited Myanmar victims in Thai government shelters to understand their needs and situations.

Myanmar delegation attended the 9th Senior Officials Meeting on Fighting Human Trafficking Program in Mekong Sub-region that was held in Bangkok, Thailand, from 21st and 22nd February 2013 and held side-line meetings with delegations from China, Thailand and Laos

to discuss the issues of cross-border trafficking. The third Myanmar- China Border Liaison Office (BLO) was opened on 15th May 2013 at Laukkai – Namsan in order to strengthen cooperation between the two countries and to liaise on transnational crime cases. Under BLO mechanism, 16 traffickers (3 males and 13 females) were arrested and handed over to Myanmar in 11 cases whereas 120 victims (6 males and 114 females) were repatriated to Myanmar through Muse-Ruili BLO offices. 6 traffickers (6 females) were arrested and handed over to Myanmar in 3 cases whereas 11 victims (11 females) were repatriated to Myanmar through Lwejei-Jangfeng BLO offices. Moreover, the third BCATIP office was opened at Myawaddy-Mae Sot on 18th October 2013. Myanmar- Thailand BCATIP meetings were held at Kawthoung, Myanmar on January 11th, January 26th, and February 5th; at Tachileik, Myanmar on May 15th and December 17th; and at Chiang Rai, Thailand on July 11th and 12th 2013. At the meeting, Myanmar would help to protect workers from trafficking.

On 9 August 2013, Myanmar Police Force Anti-Human Trafficking Special Squad, Thai Justice Department and Special Branch organized ninth anti-human trafficking consultation in Bagan on 6 and 7 August 2013 as per MOU signed between Myanmar and Thailand at Greater Mekong Sub-region Anti-Human Trafficking Ministerial Meeting in 2009. The meeting focused on human trafficking information sharing and effective action against human trafficking. In 2013, the National Anti-Trafficking in Persons Day was observed on September 13th for the first time across the country. Information about anti-trafficking activities was disseminated to the public through different media channels in a timely manner. The Anti-Trafficking in Persons Division (ATIPD), in collaboration with UNIAP and the United Nations Educational, Scientific and Cultural Organization (UNESCO), conducted the Geography Information System-GIS Mapping Training on October 2nd 2013 at Nay Pyi Taw. A mapping exercise was conducted based on the destination points of the trafficked victims in 2012.

On 29 December 2014, the Central Committee for Prevention of Trafficking in Persons meeting 2/2014 was held at the ministry in Nay Pyi Taw. As prevention plays a key role in trafficking in persons, the central committee cooperates with media, artistes and social organizations in giving educative talks on anti-human trafficking to the people. The union minister, chairman of the central committee stressed the need to uplift capacity of community watch group members for prevention of trafficking in persons. The legal affairs and prosecution working group are to draw the *2005 Anti-Human Trafficking Law* together with local and foreign experts. The Australia-Asia Program to Combat Trafficking in Persons-AAPTIP, and Human Trafficking Work Group provided technical assistance for reviewing the law. Myanmar Police Force implements a plan for combating human trafficking as a military operation across the nation. The union minister explained tasks of the central committee, successful hosting of meetings at region level and opening of a home for the human trafficked victims in border town Myawaddy on 19 December 2014 with the assistance of the Japanese government.

Myanmar attended a conference on 11 April 2015 in Cambodia aimed at strengthening regional cooperation in the fight against human trafficking. The 10th Coordinated Mekong Ministerial Initiative against Trafficking (COMMIT) Senior Officials' meeting (SOM 10) take place 28-29 April 2015 and the Fourth COMMIT Inter-Ministerial Meeting (IMM 4) on 30 April in Phnom Penh. The meeting aims to approve a new joint declaration of COMMIT to explore cooperation with other regional organizations like ASEAN. Promotion and strengthening of international and regional cooperation against human trafficking is one of the objectives of the COMMIT process. Ministers, deputy ministers and senior officials from the six Greater Mekong Sub-region countries held a discussion on the achievements of the COMMIT process and future

tasks at the inter-Ministerial meeting. Myanmar-China Meeting on Cooperation in Combating Human Trafficking held on 28 August 2015 at Muse, Myanmar. The meeting was attended by 13 Myanmar delegates and 12 Chinese delegates. At the meeting, delegates of both countries coordinated and discussed the issues as follows: to uncover and arrest collaboratively human trafficking cases with increased momentum; after Ruili Police Force finished investigation of Myanmar nationals suspects of human trafficking, to transfer them to Myanmar so that the case can be opened in a law court against them; to send personal data of Myanmar women who were rescued in Henan Province to Muse BLO; and to conduct, in collaboration of both countries, awareness raising sessions on human trafficking for Myanmar workers in Je-Gaung, Ruili and Naungtong. The 2nd Regional COMMIT Task Force Meeting held from October 15 to 16 October, 2015 at Bangkok, Thailand that was attended by Myanmar delegation who had an opportunity to share anti-trafficking interventions and best practices between countries. The Myanmar Police Force, Department of Special Investigation of Thailand and Royal Thai Police are set to hold joint coordination meetings on anti-trafficking in persons in Bagan on 26-27 January 2016. The meetings are set to discuss exchange of information and works to be done for setting up of guidelines and procedures for exchange of information. As the implementation of COMMIT process, Myanmar delegation attended the 10th COMMIT Senior Official Meeting held on 1st and 2nd February 2016 in Thailand. Myanmar – Thailand BCATIP (Border Cooperation against Trafficking in Persons) meetings were held at Tachileik, Myanmar on 15th January 2016, at Chiang Rai, Thailand on 2nd and 3rd June 2016, at Mae Sot, Thailand on 7th and 9th July 2016, at Ranong, Thailand on 16th July 2016, at Kawthoung on 24th November 2016, at Tachileik on 8th December 2016. The two governments afforded the effective cooperation to combat human trafficking between Myanmar and Thailand border.

Myanmar delegation also attended a meeting of the Coordinated Mekong Ministerial Initiative against Trafficking Task Force in Bangkok, Thailand on 18 February 2016. Reviewing two subjects each presented by six member countries on the Sub-regional Plan of Action 4 (SPA-IV) and workers to be done for the COMMIT Youth Forum and the Civil Society Organization (CSO) Platform were carried out on the first day of the meeting set to last for two days. On 3-4 March 2016 the International Organization for Migration (IOM) hosted, in cooperation with the Department of Social Welfare, the workshop on Development of National Referral Mechanisms for Protection and Assistance of Victims of Trafficking in Nay Pyi Taw under the leadership of the Central Body for Suppression of Trafficking in Person. The meeting was convened by a total 64 of representatives including Human Trafficking Working Groups, INGOs, Anti-Trafficking in Person Division, Social Welfare Department and respective ministries / departments. They discussed the basic factors for developing a national action plan to give direct assistance to victims, a legal framework in order for the government and stakeholders to approach strategically to promotion and protection of victim rights.

In the 2016-2017 fiscal years, a total amount of Myanmar Kyats 73,350,000 was given as financial support to 57 male victims and 291 female victims, totaling 348 persons. The Third Five-Year National Plan of Action (2017-2021) has been confirmed and approved in 2017. The three Strategies, four Tactics and four Areas were adopted. The 12th Senior Official Meeting (SOM 12) of the Coordinated Mekong Ministerial Initiative against Trafficking (COMMIT) was held at the MICC-II in Nay Pyi Taw on 29 November 2017. Thirteen representatives from Myanmar and 51 representatives from the SOM 12 member countries of Thailand, Vietnam, Cambodia, Laos and China attended the meeting. During the meeting, the officials discussed the latest conditions and achievements in combating human trafficking, policies for collection of employees in the region

of COMMIT and cooperation of the private sector, social organizations and youths in responding to human trafficking. In the 2017-2018 fiscal years, a total amount of Myanmar Kyats 18,700,000 has been given as financial support to 6 male victims and 23 female victims, totaling 29 persons.

Myanmar attended COMMIT Regional Workshop: COMMIT Regional Taskforce Meeting that held in Hanoi, Vietnam on 12-14 June 2018 and UN-ACT Project Management Meeting and Second Greater Mekong Sub-Regional Police Workshop that held in China on 27-28 August 2018. The 7th Bali Process Ministerial Conference and the 2nd Forum between Governments and Businessmen which were held from 6 to 7 August, 2018 in Bali, Indonesia was attended by 11 representatives led by Union Minister of Home Affairs. At the meeting, discussion was made on the implementation of promissory pledges made at the ministerial level conferences held from 2016 to 2018 and implementation of the 8 pillars in the new strategy on collaboration such as law enforcement cooperation, participation of responsible persons, exchanging information, border management, irregular migration, protection of victims and migration, repatriation and reintegration management, and collaboration and providing assistance.

Table 1. Prosecuted of Human Trafficking Cases under Anti Trafficking in Persons Law by Year

Year	Case	Traffickers	Victims
2006	52	185	195
2007	127	303	271
2008	134	359	303
2009	155	464	302
2010	173	502	381
2011	136	351	265
2012	120	325	261
2013	102	269	256
2014	124	367	309
2015	130	385	643
2016	131	408	307
2017	225	663	352
2018	206	598	317
Total	1815	5179	4162

Source: "Myanmar Five-Year National Plan of Action to Combating Human Trafficking 2018 Annual Report", The Central Body for Suppression of Trafficking in Persons, Myanmar, 2018

Research Findings and Recommendations

Combating in human trafficking requires a multidisciplinary rights-based approach, which incorporates a criminal justice response to prevent crime and deter offenders and a human rights response to protect and defend the rights and integrity of trafficked persons. Myanmar views human trafficking as a serious issue confronting humankind. Accordingly, the issue has been tackled through a comprehensive framework, including national legislation, a National Plan of Action, high-level commitment, bilateral, regional and multilateral cooperation. A great challenge in combating human trafficking is the cooperation with neighbouring countries which have different laws, procedures and policies as well as economic, social and culture factors. As Myanmar has been currently facing the challenge of trafficking in persons, the country needs to implement measures which will enhance the public awareness of various forms and negative

externalities of human trafficking and the importance of public participation in anti-trafficking in persons. Myanmar government response is so weak that the problems of human trafficking need to be approached by more effectively cooperating with the public. The increasing number of IDP and refugee camps because of internal conflicts is one of the weaknesses in combating human trafficking. Only when internal conflicts are brought to an end, such weaknesses will be lessened. The issues of irregular Myanmar migrant workers still remain at large so it is of vital importance to create job opportunities for them both internally and externally. Preventive education part of Myanmar's strive to combat human trafficking is indeed gaining momentum and found to have a certain degree of impact. However, there is an urgent need to conduct skill upgrading trainings and, to create job opportunities by Government Agencies, private entrepreneurs and international organizations for target groups who are indeed poor or are having difficulties in sustaining their livelihood, especially women. In order to reduce human trafficking, the main vulnerable group of people should be targeted in extending protection and assistance. . Myanmar was also the first country in the Mekong region to pass a comprehensive anti- human trafficking law in line with the international standards and defined by the Palermo Protocol. It was also one of the first countries in the region to establish a specialist anti trafficking police unit, which is widely regarded as best practice, and also passed a 5-Year National Plan of Action that outlines a clear roadmap for progress in all areas of anti-trafficking.`

Conclusion

The Coordinated Mekong Ministerial Initiative against Trafficking (COMMIT) is a Government-led dialogue process in the Greater- Mekong Sub-region (GMS), where all governments have recognized that they cannot combat human trafficking effectively on their own. Thus, Myanmar is striving to combat human trafficking with its own resources and in cooperation with international community. Therefore, international cooperation is necessary in addressing the problem. In order to successfully achieve its goal and objectives, Myanmar regards combating of human trafficking as a National Cause, and will strengthen its cooperation with the international community in achieving this common goal. Combining efforts on prevention of trafficking, protection of victims and their repatriation and reintegration, and prosecution of the criminals responsible, COMMIT is the superstructure on which a cohesive and comprehensive anti-trafficking response is being built.

Acknowledgements

I would like to sincere thanks to Dr Nay Win Oo, Rector, Dr Aye Aye Ko, Dr Wah Wah Lwin, and Dr Thida Aung, Pro-Rectors, East Yangon University and Dr Min Thaung, Professor and Head of the Department of International Relations for their permission to submit this research paper.

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COMPARATIVE STUDY OF CATALASE ENZYME ACTIVITY IN EIGHT VEGETABLE SAMPLES

Tin Zar Ni Tun¹, Myat Kyaw Thu², Wai Lin Oo³

Abstract

Catalase (EC 1.11.1.6) is the oxidoreductase enzyme present in aerobic microorganisms, plants, and animal tissues. Eight collected vegetable samples (spinach, coriander, kale, basil, cabbage, celery, cilantro, and mint) were screened for catalase enzyme activity. Catalase activity in the collected samples was qualitatively tested by a 6 % hydrogen peroxide test and catalase activity was proved by the liberation of oxygen gas bubbles to form foam. Extracted catalase enzyme from eight vegetable samples was partially purified through the (20 %) ammonium sulphate precipitation method. Catalase activity was examined by a spectrophotometric method using hydrogen peroxide as standard at the wavelength of 439 nm. After 20 % ammonium sulphate purification, catalase activities were increased over crude extracts in each sample. Coriander showed the highest catalase enzyme activity with the values of 2000 $\mu\text{mol min}^{-1} \text{mL}^{-1}$ in crude and 2035 $\mu\text{mol min}^{-1} \text{mL}^{-1}$ after purification. Protein content was resolved by the Biuret assay using Bovine Serum Albumin (BSA) as standard at 550 nm. Coriander, basil, and mint possess high protein contents than others. Specific activities, protein recovery, and partial purification (fold) of eight collected samples were determined in each purification step.

Keywords: H_2O_2 , catalase enzyme activity, vegetable samples, ammonium sulphate precipitation, spectrophotometric method, Biuret assay, specific activity

Introduction

Antioxidants undertake oxidation breaking the chain reaction by initiating with free radicals and are capable neutralization of free radicals. At the same time occurs inhibition of oxidation of another essential molecule (Patnaik and Basak, 2014). Enzymatic antioxidants include catalase, superoxide dismutase, peroxidase, etc. Catalase (CAT) is one of the foremost found and specified effective antioxidant enzymes. They are important ROS-scavenging enzymes of plants due to the reaction of catalases, which decompose this substance, the lifetime of hydrogen peroxide in living tissues is no longer. Hydrogen peroxide also is an important signal molecule involved in plant development and environmental responses (Chioti and Zervoudakis, 2017). In plants, nearly all catalase enzyme was occurred in peroxisomes of green leaves (Foyer and Noctor, 2000). The typical catalase reaction is the rapid disintegration of pair of hydrogen peroxide to water and molecular oxygen both are almost non-toxic to cells. There is a lot of attention on this in recent years due to the H_2O_2 link to cancer, diabetes, and ageing in humans and animals. In the modern analytical field, hydrogen peroxide is utilized as a source of an oxidizer, bleaching agent, or purifier while CAT is also quite in demand in the industry (Farhan *et al.*, 2016). For the centre of science in the public interest, some vegetable samples containing catalase are the most nutritious vegetables and they are an inexpensive source of catalase. The aim of this research paper attempts to study the degrees of enzymatic activity of catalase in collected eight vegetable samples.

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Materials and Methods

Materials

In the present investigation, Bovine Serum Albumin (BSA) was in hand from Sigma Aldrich, England. The entire chemicals used were analytical reagent grade.

Sample Collection

Eight vegetable samples (spinach, coriander, kale, basil, cabbage, celery, cilantro, and mint) were collected from Hlenden Market, Yangon Region.

Extraction of Catalase Enzyme from Eight Vegetable Samples

10 g of fresh leaves of vegetable samples were cleaned with tap water. These samples were air-dried, cut, and homogenized with 50 mL of 10 mM phosphate buffer solution (pH 7). Each vegetable sample was blended with an electrical blender and filtered with a cheesecloth. The supernatants from the previous step were centrifuged at 5500 rpm for 30 minutes. And then discarded the precipitate. Each filtrate was adjusted to 20 % saturation with ammonium sulphate (4.5362 g) and then left for 2 h in the refrigerator. After centrifugation as above, the supernatant was collected and used as a source for further analysis.

Determination of Catalase Enzyme Activity, Protein Content, Specific Activity, Protein Recovery and Partial Purification (fold) in Collected Vegetable Samples

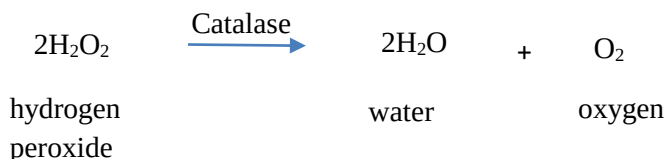
For their catalytic activity, the collected vegetable samples were qualitatively examined by a hydrogen peroxide test. For enzyme assay, the catalase activity of collected samples was examined with the carbonato-cobaltate (III) complex method at 439 nm applying H_2O_2 as a substrate (Hadwan, 2018). Protein content was determined by the Biuret assay using Bovine Serum Albumin (BSA) as standard at 550 nm. The specific activity of crude catalase samples was calculated by using enzyme activity and protein content. And also protein recovery and partial purification (fold) were computed.

Results and Discussion

Qualitative Test for Catalase Enzyme in Collected Samples

By a hydrogen peroxide test using 6 % H_2O_2 , the presence of catalase was qualitatively examined and catalase activity was confirmed by the liberation of oxygen gas bubbles to form a foam (Figure 1). For control, a buffer solution was used instead of an enzyme. In the presence of catalase, the formation of foam was recognized. However, without the catalase enzyme (control), hydrogen peroxide did not discharge oxygen to form foam.

According to this figure (1)(a)(b)(c), the control shows no enzyme activity. However, all collected vegetables were found in the formation of foam. The above experiment would be considered and simply indicated the presence of catalase in collected samples. The more bubbles produced the faster catalase is carrying out this reaction, or the more catalase present. It was observed that coriander has high catalase activity than spinach, kale, basil, cabbage, celery, cilantro, and mint.



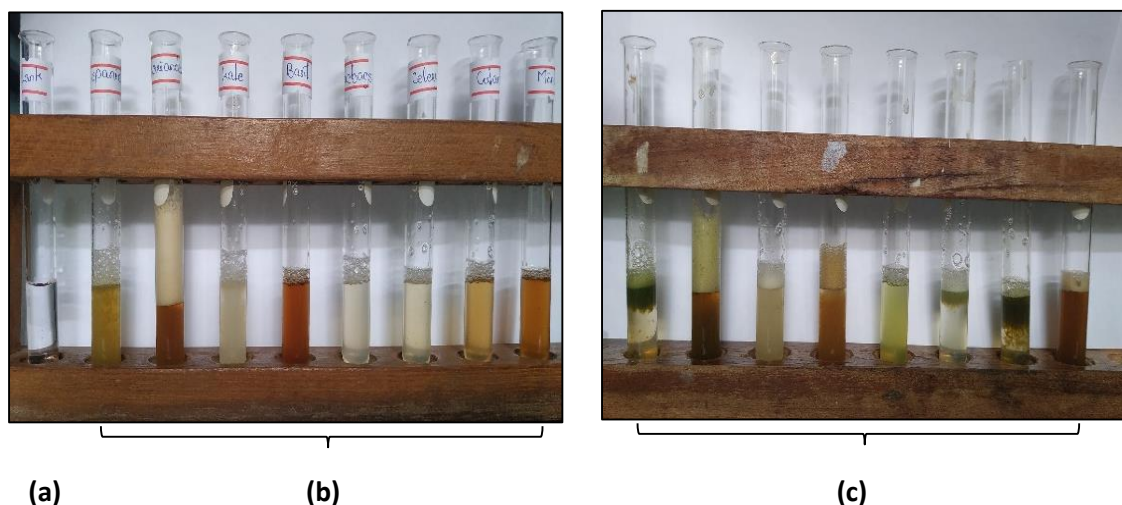


Figure 1 (a) 6 % H_2O_2 solution without enzyme (control) (b) 6 % H_2O_2 solution with a 20 % ammonium sulphate saturation enzyme-containing samples (c) 6 % H_2O_2 solution with crude enzyme-containing samples at room temperature

The Wavelength of Maximum Absorption of Hydrogen Peroxide

In this study, Cobalt-bicarbonate reagent was used as a stop bath for reactions managed by the catalase enzyme. The spectrum of the formed color end product was searched from 400 to 800 nm and displayed bands at 439 nm and 640 nm (Figure 2). In the present work, a 439 nm band was employed for determining catalase activity.

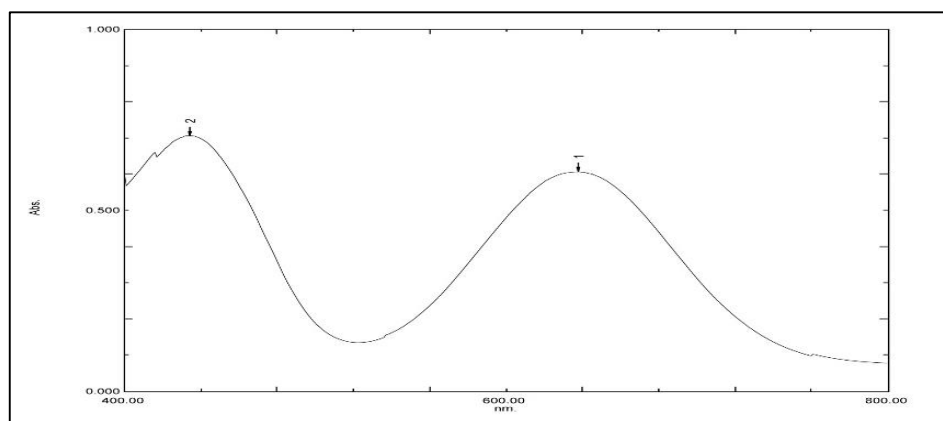


Figure 2 Wavelength of maximum absorption of hydrogen peroxide

Construction of Calibration Curve for Standard H_2O_2 Solutions

The absorbance of different hydrogen peroxide solutions (2.5, 5, 10, 15, 20, 25, 30, 35, 40) mM was measured at 439 nm with a UV-visible spectrophotometer. At the wavelength of 439 nm, the calibration curve of absorbance against the concentration of standard hydrogen peroxide concentration was plotted (Table 1, Figure 3). The nature of the curve was a straight line passing through the origin showing that Beer's Law was obeyed.

Table 1 Relationship between Absorbance at 439 nm and Standard Hydrogen Peroxide Concentration

No.	Concentration (mM)	Absorbance at 439 nm
1	2.5	0.032
2	5	0.047
3	10	0.086
4	15	0.150
5	20	0.236
6	25	0.290
7	30	0.358
8	35	0.397
9	40	0.441

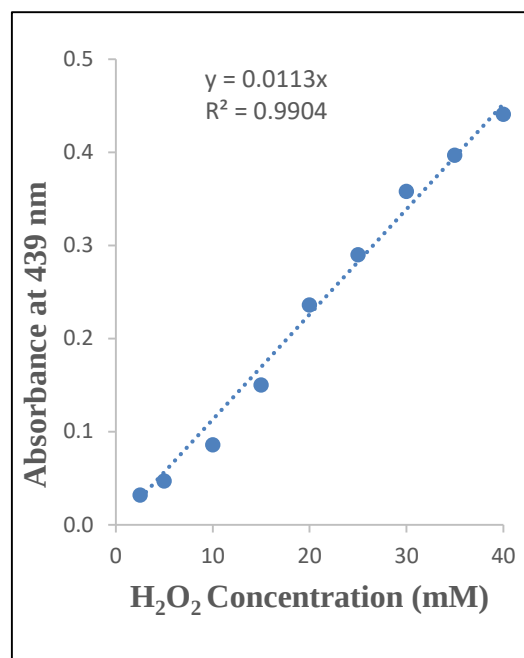


Figure 3 The plot of absorbance as a function of concentration for standard hydrogen peroxide solution

Catalase Enzyme Activity in Collected Vegetable Samples

Hydrogen peroxide (30 mM) was used as a substrate to determine the enzyme catalase activity of eight collected samples. The CAT activity was measured spectrophotometrically by monitoring the reduction in absorbance at 439 nm under the defined test conditions with minor modifications. At once after combining the working solution with the enzyme solution, the oxidation number of its content cobalt oxidized from (II) to (III). Because excess unreacted hydrogen peroxide resulting from catalase enzyme-substrate reaction had oxidized and then be active with carbonate to form a deep olive green color carbonato-cobaltate (III) complex ($[\text{Co}(\text{CO}_3)_3] \text{Co}$). The rate of decomposition of hydrogen peroxide in the test samples was a usually linear relationship with the catalase enzyme activity. The color intensity was used in the assessment of catalase activity. The reduction of color intensity displays an elevation of catalase activity. One unit of catalase activity is designated as that quantity of enzyme activity needed to convert $1 \mu\text{mol}$ of H_2O_2 to water and oxygen per min (Hadwan, 2018).

The catalase activities of eight collected samples were calculated from the absorbance values by measuring at 439 nm of a UV-visible spectrophotometer. According to the data results, the activities of catalase were elevated after 20 % ammonium sulphate precipitation over crude extract. The activity of basil and mint was lower than that of spinach, kale, cabbage, celery, and cilantro. The activity of coriander was the highest among the collected samples.

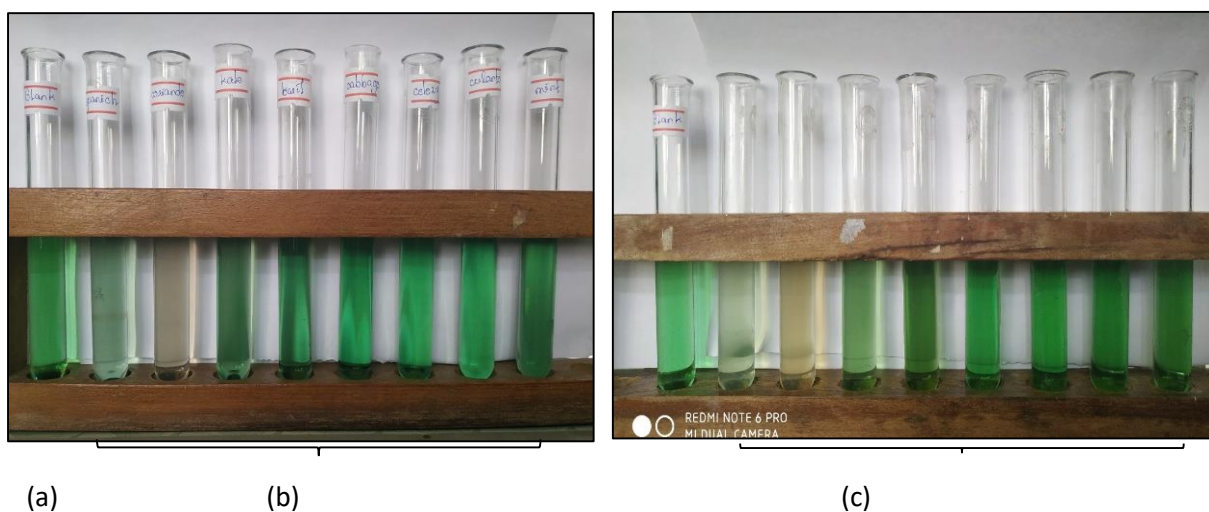


Figure 4 (a) 30 % H_2O_2 solution without enzyme (control) (b) 30 % H_2O_2 solution with a 20% ammonium sulphate saturation enzyme-containing samples (c) 30 % H_2O_2 solution with crude enzyme-containing samples

Table 2 Catalase Enzyme Activity in Collected Enzyme-containing Vegetable Samples

No.	Vegetable Samples	Catalase Enzyme Activity ($\mu\text{mol min}^{-1}\text{mL}^{-1}$)	
		Crude	After 20 % $(\text{NH}_4)_2\text{SO}_4$ saturation
1	Spinach	863.72	1175.22
2	Coriander	2000.00	2035.00
3	Kale	424.78	467.26
4	Basil	169.91	240.71
5	Cabbage	332.74	601.77
6	Celery	141.59	580.53
7	Culantro	70.79	396.46
8	Mint	233.63	304.43

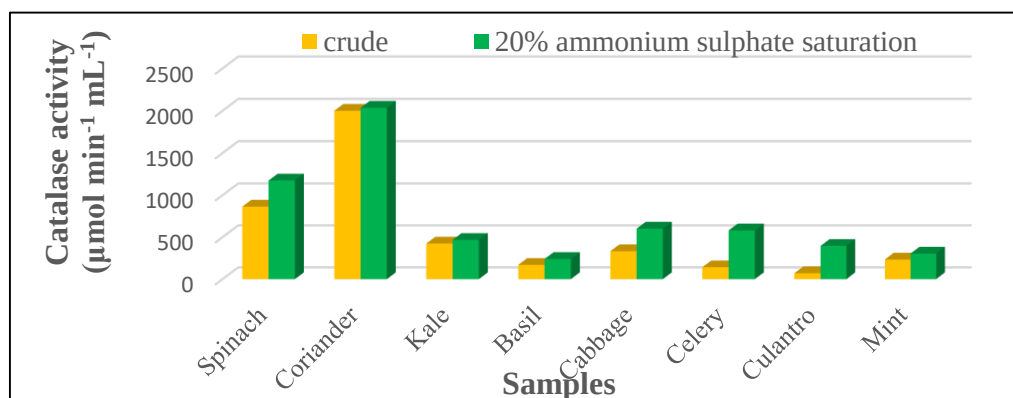


Figure 5 Catalase activity in collected vegetable samples

The Wavelength of Maximum Absorption of Copper-Protein Complex in Biuret Assay

The Biuret assay is the most generally employed essay for total protein detection. The absorption spectrum of the copper-protein complex was recorded in the range of 400-800 nm (Figure 6) and the absorption spectra showed a maximum peak at 550 nm.

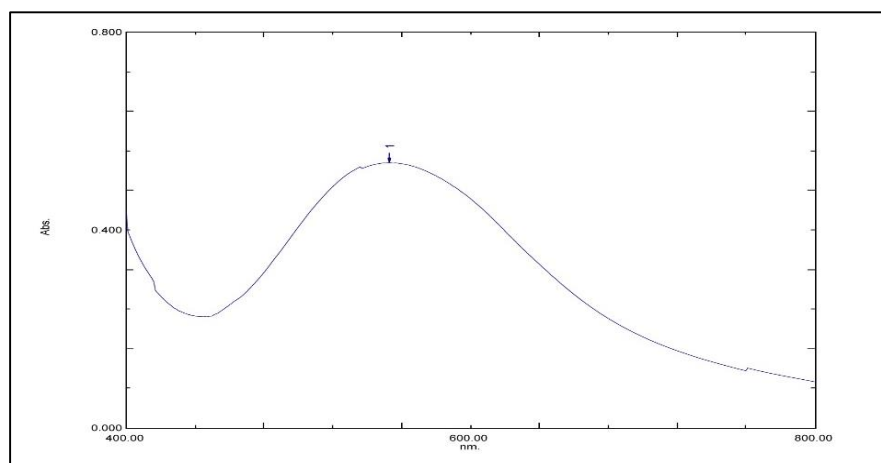


Figure 6 Wavelength of maximum absorption of the copper-protein complex in the biuret method

Construction of Calibration Curve for Protein Determination by Biuret Assay

In this research, the determination of protein by using bovine serum albumin (BSA) as standard is a modification of the dye-binding method of Biuret (Savary *et al.*, 1969). At the wavelength of 550 nm, the calibration curve of absorbance versus the concentration of bovine serum albumin (BSA) was drawn (Table 3 and Figure 7). The nature of the curve was a straight line passing through the origin showing that Beer's Law was obeyed.

Protein Content in Collected Vegetable Samples

The protein content was determined by Biuret method and the results were shown in Table 4.

It was found that the protein contents of 20 % ammonium sulphate fractions declined more than that of crude extracts. The protein contents of cabbage and celery were significantly decreased. Coriander, basil, and mint possessed high protein levels than others.

Table 3 Relationship between Absorbance and Standard Protein Concentration using Biuret Method

No.	Standard Protein Concentration (mg / mL)	Absorbance at 550 nm
1	1	0.064
2	2	0.119
3	4	0.225
4	6	0.347
5	8	0.466
6	10	0.572

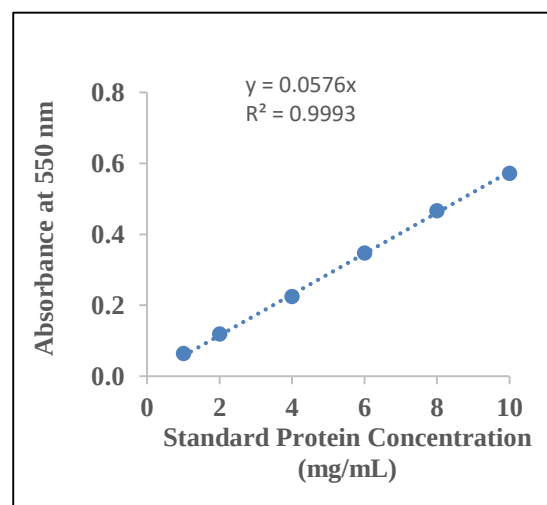


Figure 7 The plot of absorbance as a function of the concentration of standard protein solution

Table 4 Protein Content in Collected Vegetable Samples

No.	Vegetable Samples	Protein Content (mg mL ⁻¹)	
		Crude	After 20 % (NH ₄) ₂ SO ₄ saturation
1	Spinach	7.95	5.64
2	Coriander	20.16	16.84
3	Kale	6.36	6.10
4	Basil	25.14	18.62
5	Cabbage	14.54	3.58
6	Celery	18.02	6.00
7	Culantro	10.27	5.98
8	Mint	19.19	17.15

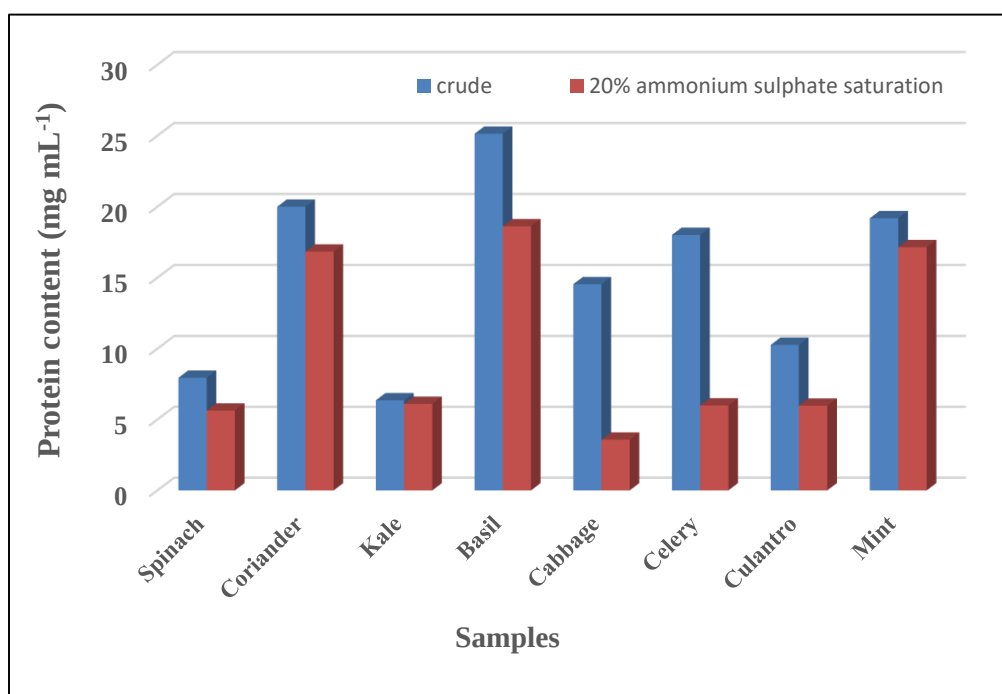


Figure 8 Protein content in collected vegetable samples
Protein Recovery, Specific Activity and Partial Purification (fold) in Collected Vegetable Samples

In the present study, it was deduced that the protein recovery, specific activity, and partial purification (fold) in eight collected samples. The observations were shown in Tables 5 and 6.

Table 5 Total Volume, Total Protein Content and Protein Recovery in Collected Vegetable Samples

No.	Vegetable Samples	Total Volume (mL)		Total Protein Content (mg)		Protein Recovery (%)	
		Crude	After 20 % (NH ₄) ₂ SO ₄ saturation	Crude	After 20 % (NH ₄) ₂ SO ₄ saturation	Crude	After 20 % (NH ₄) ₂ SO ₄ saturation
1	Spanish	45	40	357.75	225. 60	100	60.06
2	Coriander	45	40	907.20	673. 60	100	74.25
3	Kale	45	40	274. 50	254. 40	100	92. 68
4	Basil	45	40	1131.30	744.80	100	65.84
5	Cabbage	45	40	654.30	143.20	100	21.89
6	Celery	45	40	810.90	240.00	100	29. 59
7	Culantro	45	40	462.15	239.20	100	51.76
8	Mint	45	40	863. 55	686.00	100	79.44

Table 6 Total Enzyme Activity, Specific Activity and Partial Purification (fold) in Collected Vegetable Samples

No.	Vegetable Samples	Total Enzyme Activity (mmol min ⁻¹)		Specific Activity (mmol min ⁻¹ mg ⁻¹)		Partial Purification (fold)	
		Crude	After 20 % (NH ₄) ₂ SO ₄ saturation	Crude	After 20 % (NH ₄) ₂ SO ₄ saturation	Crude	After 20 % (NH ₄) ₂ SO ₄ saturation
1	Spanish	388.67	470.09	1.09	2.08	1	1.9
2	Coriander	900.00	814.00	0.99	1.21	1	1.2
3	Kale	169.91	191.15	0.62	0.75	1	1.2
4	Basil	764.60	962.83	0.68	1.29	1	1.9
5	Cabbage	149.74	240.71	0.23	1.68	1	7.3
6	Celery	63.72	232.21	0.08	0.97	1	12.1
7	Culantro	31.86	158.58	0.07	0.66	1	9.4
8	Mint	105.13	121.77	0.12	0.18	1	1.5

In this research, the protein recovery was in the range of 21 % to 93 %. Kale possessed the highest protein recovery while cabbage was the lowest. There were expanded specific activities after purification with ammonium sulphate (20 %). The partial purification (fold) was calculated by using the specific activity of crude extract and 20 % extract of each sample. partial purification (fold) was seen in the increasing order among samples kale, coriander < mint < basil, spinach < cabbage < culantro < celery.

Conclusion

The present paper reported the degrees of enzymatic activity of catalase in fresh and mature eight vegetable samples (spinach, coriander, kale, basil, cabbage, celery, culantro, and mint). These collected samples were partially purified with the (20 %) ammonium sulphate precipitation method. The quality of crude and partially purified catalase were screened by 6 % hydrogen peroxide and catalase activity was proved by the liberation of O₂ gas bubbles to form foam. According to qualitative test results, all collected vegetable samples have the catalase enzyme activity. The more the foam produced the better the catalase enzyme activity. By seeing the formation of bubbles, can roughly know that coriander has high catalase activity than spinach, kale, basil, cabbage, celery, culantro, and mint. By spectrophotometric method at 439 nm, the activities of catalase and specific activities were raised after purification with ammonium sulphate although the protein contents were declined at 550 nm. Among these collected samples, Coriander was recorded to be the plant with the maximum catalase activity in both qualitative and quantitative test results followed by spinach. It was found that the samples which possess a high partial purification fold had low protein recovery. From this study, it could be concluded that the collected eight vegetable samples own predominant free radical scavenging catalase activity according to the results. As a source of catalase, these collected eight vegetable samples can be used beneficially in therapeutic. Catalase, primarily observed and expressed in collected samples, is one of the considerable enzymes for the elimination of H₂O₂.

Acknowledgements

The authors would like to thank the Department of Higher Education, Ministry of Education, Yangon, Myanmar. We would like to express our sincere thanks to Rector, Dr Nay Win Oo, Pro-Rectors Dr Aye Aye Ko, Dr Wah Wah Lwin, and Dr Thidar Aung, East Yangon University. Our heartfelt thanks are also enhanced to Dr Myo Myo Myat (Professor and Head), Dr Than Than Oo, and Dr Myint Myint May (Professors), Department of Chemistry, East Yangon University for their kind encouragement and permission to submit this paper and provide many helpful suggestions.

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STUDIES ON THE EFFECT OF RIPENING AGENT UPON BANANA SAMPLES (Phee-Gyan and Thee-Hmwe)

Aye Thandar Win¹, Nu Nu Win²

Abstract

Banana is a good source of nutrients. It is the basic food in many tropical countries. Banana has high nutritive value and very characteristic flavour. In present research, banana samples (Phee-Gyan) *Musa paradisiaca L. Bluggoe* and (Thee-Hmwe) *Musa paradisiaca L. Acuminata colla* were soaked in ripening agent solution (ethephon) 2-chloroethyl phosphonic acid at a concentration of 0.2 mL per liter for 5 minutes. The samples ripened within 4 days. The change in nutritional values, contents of trace elements, sugar and vitamin C in natural ripening and treated ripening banana were investigated. The nutrient values such as water, ash, fat, fiber and protein were found to be significantly unchanged in treated banana. Carbohydrate content was slightly changed. The elements investigated by Atomic Absorption Spectrophotometry were potassium, calcium, magnesium, phosphorus and iron. According to elemental contents potassium, calcium, magnesium and iron were not altered but phosphorus content were increased in treated banana sample and it may be due to the presence of phosphorus in ripening agent (ethephon). Although the sugar content in treated Phee-Gyan sample slightly decreased, that in Thee-Hmwe sample was not altered. The vitamin C content in natural and treated banana samples (Phee-Gyan and Thee-Hmwe) were slightly increased.

Keywords: Ethephon, banana, physicochemical properties, elemental contents, sugar, vitamin C

Introduction

Banana originally came from Indo-Malaysia, Asia area and are now cultivated all over the tropical and sub-tropical continents. Banana plants can grow up to 15 m but most plants vary from 3 to 9 m. It has very big leaf that can grow to 4 × 1 m. Generally, ranges from 9 to 18 months. Harvesting take place when the fingers have filled to an adequate diameter, which varies with the marketing needs (Gereuter, 1994).

Bananas are delicious and eaten raw after peeling off the skin. Depending on the type of banana unripe bananas are also cooked, fried or deep fried a lot. Bananas are good source of nutrients. Bananas are rich in potassium, calcium, magnesium, phosphorus, iron, carbohydrate, fiber and sugar. They are also a good source of vitamin A and C as well as thiamine, riboflavin and niacin. At least one banana was eaten a day, they are said to contain everything a human need and they contain all the 8 amino acids (Raghuramulu *et al.*, 1983).

The residue or ash left after food is heated at a high temperature for about an hour is called the mineral matter sometimes called mineral salts or inorganic nutrients. Inorganic nutrients have three main functions in the body. The first one, they form part of the body structure. Calcium, magnesium and phosphorus are mainly used to form the bones and teeth. The second one, they form part of the fluids in the tissues and assist in the control of pH and osmotic functions. The pH is controlled within narrow limits by the buffering actions of the ions present. For example, blood is buffered at pH 7.4 by the hydrogen carbonate ions and carbonates present. Finally, they are an essential component of a large number of enzymes which are necessary for the release and utilization of energy (Sanyal, 1964).

Botanical Aspect of Banana

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Scientific name	<i>Musa paradisiaca</i> <i>L. Bluggoe</i>	<i>Musa paradisiaca</i> <i>L. Acuminata colla</i>
Family name	<i>Musaceae</i>	<i>Musaceae</i>
Myanmar name	Phee-Gyan	Thee-Hmwe
English name	Banana	Banana

Ripening Agents

Chemical Name	: 2 chloroethyl phosponic acid (IUPAC)
Structural Formula	: $\text{ClCH}_2\text{CH}_2\overset{\text{O}}{\underset{\text{ }}{\text{P}}}(\text{OH})_2$
Empirical Formula	: $\text{C}_2\text{H}_6\text{ClO}_3\text{P}$
Common Name	: Ethephon



Materials and Methods

Sample Collection

Banana samples (Phee-Gyan) *Musa paradisiaca L. Bluggoe* and (Thee-Hmwe) *Musa paradisiaca L. Acuminata colla* were purchased from retail market. Ethephon (2-chloroethyl phosphonic acid) was purchased from food preservative selling shop.

Sample Preparation

Banana samples (Phee-Gyan and Thee-Hmwe) were soaked in ripening agent solution (ethephon) at a concentration of 0.2 mL per liter for 5 minutes. The samples ripened within 4 days.

Determination of Nutritional Values

Nutritional parameters such as water, ash, fat, fiber, protein and carbohydrate were determined by standard AOAC method (AOAC, 2000).

Determination of Elemental Contents

Elemental contents of natural and treated banana samples such as potassium, calcium, magnesium, phosphorus and iron were determined by Atomic Absorption Spectrophotometry (AAS).

Determination of Sugar Content

Sugar contents in natural and treated banana samples were determined by iodometric titration.

Determination of Vitamin C Content

The vitamin C content in natural and treated banana samples were determined by iodometric titration.

Results and Discussion

Nutritional Values of Banana Samples

Nutritional values of natural and treated banana (Phee-Gyan) sample were shown in Table 1 and Figure 1. These values for (Thee-Hmwe) were also presented in Table 2 and Figure 2. From these results, it can be seen that the contents of water, ash, fat, fiber and protein were not significantly changed but carbohydrate content was slightly changed. The water content is usually determination by drying to constant weight and considering the loss in weight as water. The water contents of natural and treated banana (Phee-Gyan) samples were found to be 70.25 % and 69.24 %, that in Thee-Hmwe samples were 63.37% and 61.90% respectively.

The ash in food stuff is the inorganic residue remaining after the organic matter has been burnt away. The ash contents of natural and treated banana (Phee-Gyan) samples were found to be 0.58 % and 0.59 % respectively. Ash contents in (Thee-Hmwe) samples were observed that 0.82 % and 0.67 % respectively.

The fat contents in natural and treated banana (Phee-Gyan) samples were observed to have the same value of 0.26% and in Thee-Hmwe samples 0.29 % and 0.28 %. From the results, fat contents were found to be slightly changed in Thee-Hmwe.

Proteins have multiple functions, acting as enzymes and hormones, main airing proper fluid. Protein are highly complex, nitrogenous organic compounds which are found as components of all living matter and that essential to life process and are necessary constituents of animals foods. In plants, protein is found in all living parts but usually in relatively small quantities except in the seed. Protein contents in natural and treated banana (Phee-Gyan) samples were 0.76 % and 0.69 % respectively. Thee-Hmwe sample were determined to be 1.49 % and 1.70 % respectively.

The main role of fiber is to keep the digestive system healthy. Fiber the other important category of complex carbohydrate is also gaining popularity for health reasons. Fiber found in small amounts in animals tissue. And like starches, dietary fiber is found abundantly in plants, especially in outer vegetables. Fiber contents in natural and treated banana (Phee-Gyan) sample were 0.49 % and 0.53 % respectively. Thee-Hmwe sample were found to be observed 0.38 % and 0.32 % respectively.

Carbohydrates provide a person with energy. People can also obtain energy from foods containing protein and fats, but carbohydrates are the body's preferred source. Carbohydrates break down into glucose in the body. Glucose moves from the bloodstream into the body's cells with help of the hormone insulin.

Carbohydrate contents of natural and treated (Phee-Gyan) sample were 27.66 % and 23.69 % respectively. Thee-Hmwe sample were determined to be 33.65 % and 35.13 %. Carbohydrate contents were slightly changed.

Table 1. Nutritional Values of Natural and Treated Banana Samples (Phee-Gyan)

No.	Parameter	Content (mg / 100g)	
		Natural Banana	Treated Banana
1	Water	70.25 ± 0.03	69.24 ± 0.21
2	Ash	0.58 ± 0.04	0.59 ± 0.11
3	Fat	0.26 ± 0.14	0.26 ± 0.14
4	Fiber	0.49 ± 0.04	0.53 ± 0.03
5	Protein	0.76 ± 0.01	0.69 ± 0.18
6	Carbohydrate	27.66 ± 0.32	28.69 ± 0.13

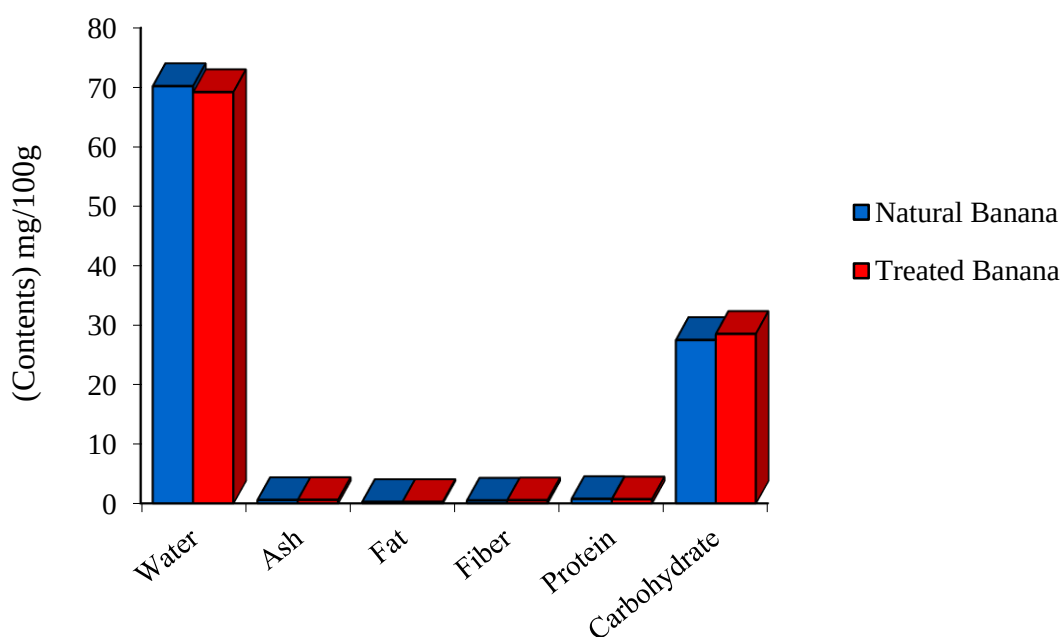
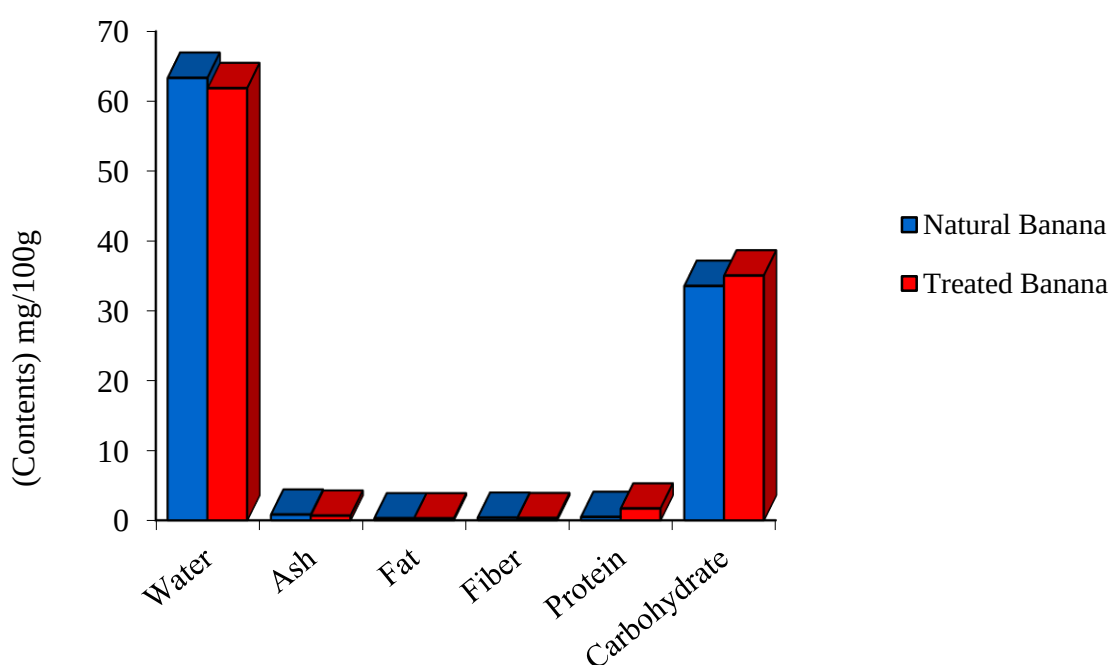


Figure 1. Nutritional values of natural and treated banana samples (Phee-Gyan)

Table 2. Nutritional Values of Natural and Treated Banana Samples (Thee-Hmwe)

No.	Parameter	Content (mg / 100g)	
		Natural Banana	Treated Banana
1	Water	63.37± 0.03	61.90 ± 0.02
2	Ash	0.82 ± 0.15	0.67 ± 0.21
3	Fat	0.29 ± 0.01	0.28 ± 0.08
4	Fiber	0.38 ± 0.12	0.32 ± 0.01
5	Protein	0.49 ± 0.31	1.70 ± 0.52
6	Carbohydrate	33.65 ± 0.07	35.13 ± 0.09

**Figure 2. Nutritional values of natural and treated banana samples (Thee-Hmwe)**

Elemental Contents of Natural and Treated Banana

In present investigation, the elemental contents were detected for natural and treated banana (Phee-Gyan and Thee-Hmwe) by Atomic Absorption Spectrophotometry (AAS).

The elements were investigated in this study were potassium, calcium, magnesium, phosphorus and iron. These elements were selected because of their important biological role in human body.

Potassium is necessary for the transmission of nerves impulse that provide smooth co-ordinated muscle movement. It also helps widen the blood vessels during exercise.

Calcium is essential for all life. It forms part of cell walls and bones. Calcium also helps to prevent cramp brought on exercise by avoiding lactice acid. Magnesium is essential part of many enzymes and important to maintain electrical potential in nerves and muscles membranes.

Magnesium deficiency results in nausea, irritability, muscle weakness, twitching, cramps and cardiac arrhythmias.

Iron is necessary for the oxygenation of red blood cells, a healthy immune system for energy production. It is essential for haemoglobin and brain function. (Olagunju, 1995)

The main function of phosphorus is in the formation of bones and teeth. Phosphorus also helps remove waste and repair damaged tissues. (O'Dell *et al.*, 1997)

Elemental contents in natural and treated banana samples (Phee-Gyan and Thee-Hmwe), contents of potassium, calcium, magnesium and iron were distinctly unchanged. But phosphorus content was found to be increased in treated banana sample and it may be the presence of phosphorus in ripening agent. The elemental contents of natural and treated banana samples (Phee-Gyan and Thee-Hmwe) were shown in Table 3, Figure 3 and Table 4, Figure 4.

Table 3. Elemental Contents of Natural and Treated Banana Samples (Phee-Gyan)

No.	Element	Content (mg / L)	
		Natural Banana	Treated Banana
1	Potassium (K)	50.95 ± 0.102	51.41 ± 0.023
2	Calcium (Ca)	17.08 ± 0.027	18.90 ± 0.032
3	Magnesium (Mg)	10.93 ± 0.049	10.84 ± 0.009
4	Phosphorus (P)	40.02 ± 0.064	48.00 ± 0.053
5	Iron (Fe)	0.58 ± 0.003	0.52 ± 0.012

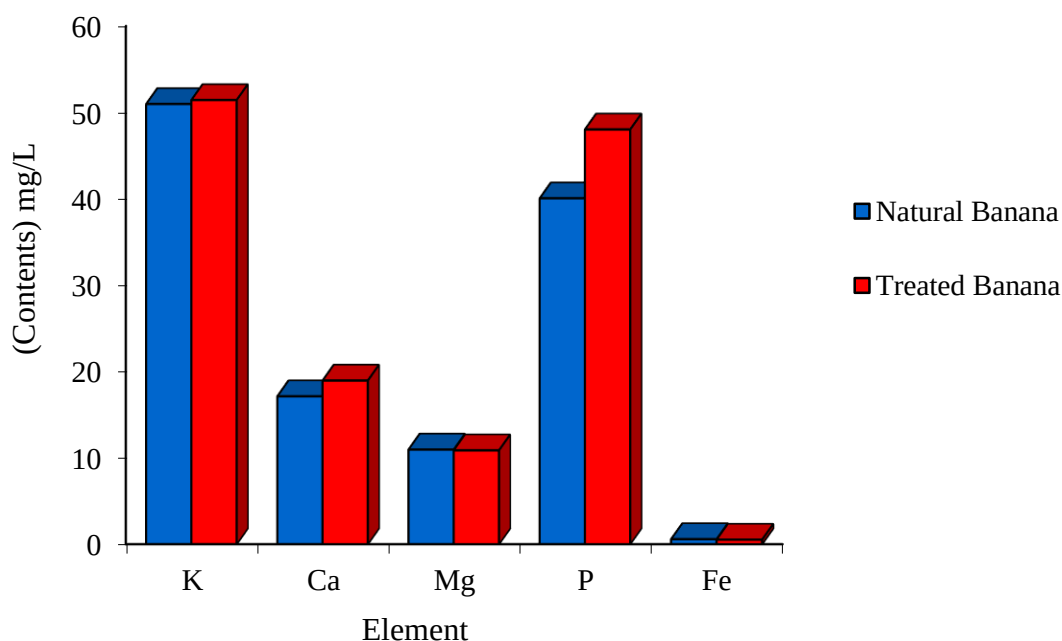
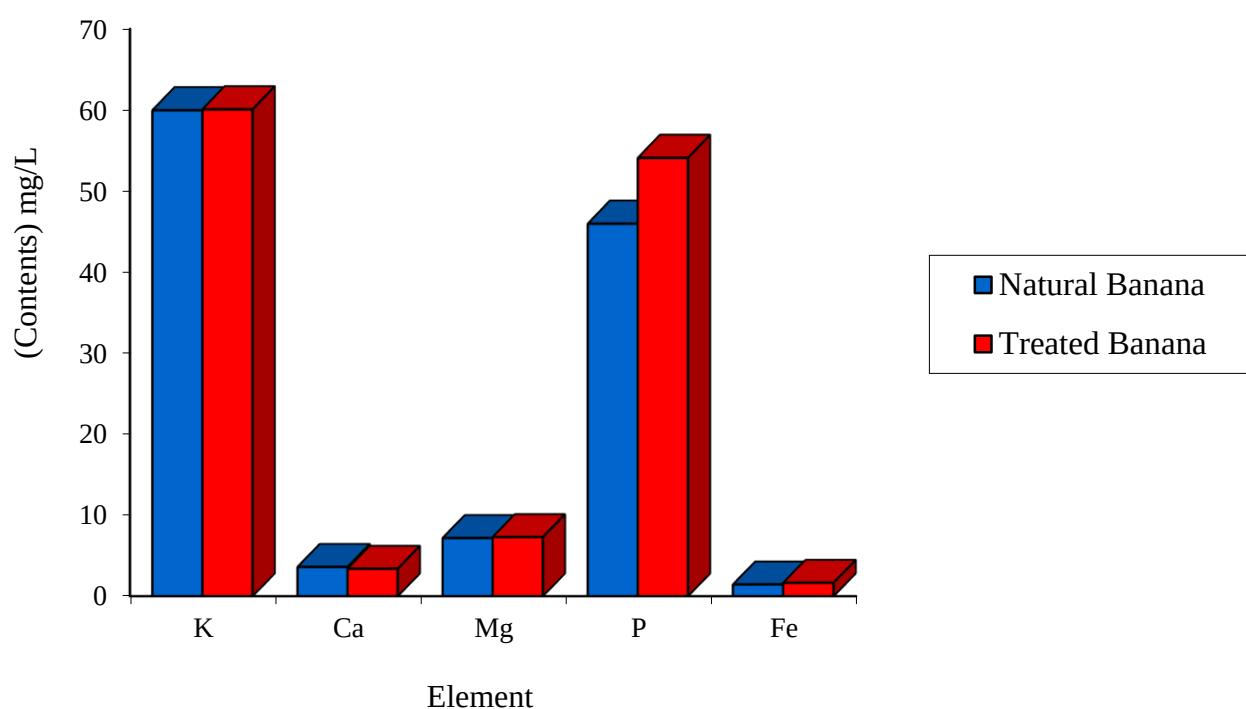


Figure 3. Elemental contents of natural and treated banana samples (Phee-Gyan)

Table 4. Elemental Contents of Natural and Treated Banana Samples (Thee-Hmwe)

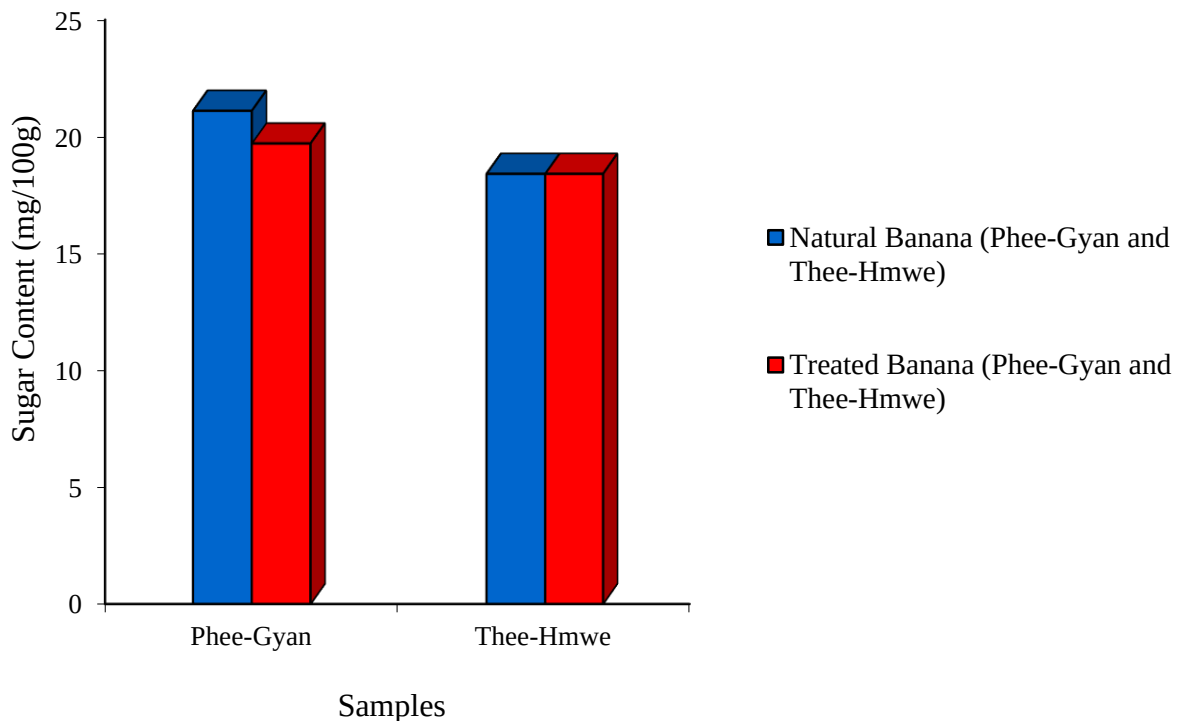
No.	Element	Content (mg / L)	
		Natural Banana	Treated Banana
1	Potassium (K)	59.98 ± 0.002	60.09 ± 0.006
2	Calcium (Ca)	3.63 ± 0.083	3.40 ± 0.031
3	Magnesium (Mg)	7.23 ± 0.015	7.34 ± 0.017
4	Phosphorus (P)	46.02 ± 0.014	54.12 ± 0.051
5	Iron (Fe)	1.44 ± 0.127	1.65 ± 0.064

**Figure 4. Elemental contents of natural and treated banana samples (Thee-Hmwe)****Sugar Content in Banana Samples (Phee-Gyan and Thee-Hmwe)**

Sugar represented that part of the fruit which is used by micro organic for single cell protein and alcohol production (Oura, 1983). The potential of banana as an energy crop was estimated by Ayanru, 1985 who shows that it has a capacity of generating ethanol by microbial conversion of sugars in the banana fruit. The content of total sugar in natural and treated banana were shown in Table 5 and Figure 5. Although the sugar content in treated Phee-Gyan sample slightly decreased, that in Thee-Hmwe sample was not altered.

Table 5. Sugar Content in Banana Sampels (Phee-Gyan and Thee-Hmwe)

Sugar Content (mg / 100g)			
Phee-Gyan		Thee-Hmwe	
Natural	Treated	Natural	Treated
21.1	19.7	18.4	18.4

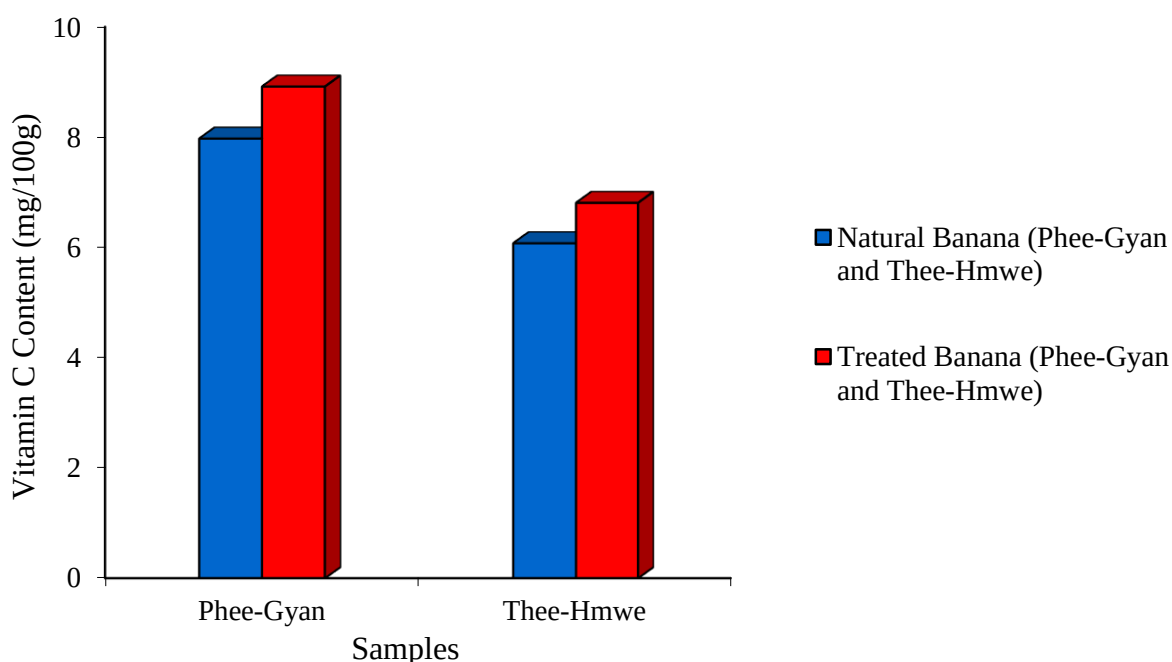
**Figure 5. Sugar content in banana sampels (Phee-Gyan and Thee-Hmwe)****Vitamin C Content of Banana Samples (Phee-Gyan and Thee-Hmwe)**

Vitamin C is an essential nutrient for health maintenance. The National Research Council has suggested a vitamin C intake of 75-100 mg per day for human nutrition. (William, 1980)

In this study, the vitamin C content (mg/ 100g) in natural and treated banana samples (Phee-Gyan) were 7.98 and 8.92. Thee-Hmwe samples were found to be 6.09 and 6.82. From these results, it can be seen that vitamin C content were slightly increased in both samples by using ripening agent. Vitamin C content in natural and treated banana samples (Phee-Gyan and Thee-Hmwe) were shown in Table 6 and Figure 6.

Table 6. Vitamin C Content in Banana Samples (Phee-Gyan and Thee-Hmwe)

Vitamin C Content (mg / 100g)			
Phee-Gyan		Thee-Hmwe	
Natural	Treated	Natural	Treated
7.98	8.92	6.09	6.82

**Figure 6. Vitamin C content in banana samples (Phee-Gyan and Thee-Hmwe)**

Conclusion

In this research work, the change in nutritional values, contents of trace elements, sugar and vitamin C in natural ripening and treated ripening banana samples (Phee-Gyan and Thee-Hmwe) were investigated. The nutrient values such as water, ash, fat, fiber and protein were found to be significantly unchanged in treated banana. Carbohydrate content was slightly changed.

The elements investigated in this potassium, calcium, magnesium, iron and phosphorus. These elements were selected because of their important biological role in human body. According to elemental contents, phosphorus content increased by using ripening agent. It may be due to the presence of phosphorus in ripening agent.

Although the sugar content in treated Phee-Gyan sample slightly decreased, that in Thee-Hmwe sample was not altered.

The vitamin C content in natural and treated banana samples (Phee-Gyan and Thee-Hmwe) were slightly increased in both samples. Therefore, it may be concluded that, the ripening agent cannot significantly affect on detected parameters.

Acknowledgements

We would like to express their deep gratitude to the Department of Higher Education, Ministry of Education. We also indebted to Rector Dr. Nay Win Oo, Pro-Rectors Dr. Aye Aye Ko, Dr. Wah Wah Lwin and Dr. Thidar Aung, East Yangon University. Our warmest thanks are also extended to Dr. Myo Myo Myat (Professor and Head), Professors Dr. Than Than Oo and Dr. Myint Myint May, Department of Chemistry, East Yangon University for their effective suggestion, comments, encouragement and allowing for submission of this paper.

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INVESTIGATION ON PHYTOCHEMICALS, ANTIOXIDANT ACTIVITY AND TOTAL PHENOL CONTENT OF *ADIANTUM CAPILLUS-VENERIS* L. (MAIDENHAIR FERN)

Myint Sandi Kyaw*

Abstract

In the present work, some biological activities of *Adiantum capillus-veneris* L. (Maidenhair fern) were investigated. The preliminary phytochemical tests revealed the presence of alkaloids, α -amino acids, carbohydrates, flavonoids, glycosides, phenolic compounds, polyphenolic compounds, reducing sugars, saponins, steroids, tannins and terpenoids but starch was found to be absent in this sample. Antioxidant activities of ethyl acetate, ethanol and water extracts from fronds of the fern were determined by using DPPH radical scavenging method in which ascorbic acid was used as a standard antioxidant. On comparison of IC_{50} values, the highest antioxidant activity was observed in ethanol extract with IC_{50} value of 62.76 μ g/mL and the lowest for water extract with IC_{50} value of 167.85 μ g/mL. Total phenol contents of these extracts were measured by Folin-Ciocalteu method. Total phenol contents of ethanol extract was found to be the highest (260.00 ± 9.005 μ g GAE/mg) followed by ethyl acetate (104.00 ± 7.000 μ g GAE/mg) and water extract (88.00 ± 4.444 μ g GAE/mg).

Keywords: *Adiantum capillus - veneris* L., phytochemical tests, antioxidant activities, total phenol

Introduction

Ferns are plants that do not have flowers. Ferns generally reproduce by producing spores. Similar to flowering plants, ferns have roots, stems and leaves. However, unlike flowering plants, ferns do not have flowers or seeds; instead, they usually reproduce sexually by tiny spores or sometimes can reproduce vegetative as exemplified by the walking fern. The leafy branch of the fern is usually called a frond. A frond is a large, divided leaf. In both common usage and botanical nomenclature, the leaves of ferns are referred to as fronds. *Adiantum* is a genus of about 200 species of ferns in the family *Adiantaceae*, distributed extensively over the world from cool temperate zones to hot tropical regions. In literature, the maidenhair fern has been reported to have diverse medicinal uses in the indigenous systems of medicine. It has been used in cold, skin diseases, bronchitis, hair fall and inflammatory diseases. It is also considered as tonic and diuretic. So, the present work is intended to investigate some bioactivities of the fern which are rich in important secondary metabolites such as polyphenols, flavonoids responsible for the therapeutic effects of the plant (Al-Snafi, 2015).

Medicinal Uses

Adiantum capillus-veneris L. is one of such plants in folk medicine that has been used for the management of various diseases. The traditional uses recorded for this herb are numerous and mainly medicinal. The whole herb is used as medicine in various forms like decoction, powder, oil etc. in different ailments.

In South Africa, tribals inhale the smoke of dried leaves to check headache, and cold. In the Punjab, the leaves along with pepper, are administered as a febrifuge, and in South India, when prepared with honey, they are used in catarrhal affection. At Mexico, this plant is used as a tea to relieve colic. The herb is mucilaginous, pectoral, expectorant and is used as a popular cough medicine throughout most parts of Europe. It has also been used emmenagogue. In France, large

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quantities are employed for all coughs, throat affections and bronchial disorders. Expressed juice with pepper is a favorite remedy in all kinds of fever. The dried whole plant is used as an antipyretic and diuretic. The fern is cultivated as an ornamental plant in Japan and Europe because of its beautiful evergreen frond (Vadi *et al.*, 2017).

Antioxidant and Free Radicals

Antioxidants are compounds capable of either delaying or inhibiting the oxidation processes which occur under the influence of atmospheric oxygen or reactive oxygen species. Antioxidants are involved in the defense mechanism of the organism against the pathologies associated to the attack of free radicals. The main characteristics of an antioxidant is its ability to trap free radicals (Pisoschi and Negulescu, 2011). Free radicals contribute to more than one hundred disorders in humans including atherosclerosis, arthritis, central nervous system injury, gastritis, cancer and AIDS. Free radicals are due to environmental pollutants, radiation, chemicals, toxins, deep fried and spicy foods as well as physical stress (Pourmorad and *et al.*, 2006). Free radical chemical reactions and several redox reactions of various compounds may cause protein oxidation, DNA damage and lipid per-oxidation in living cells. Therefore, oxidation have been claimed to play an important role in human health implicated in several diseases, including cancer, hypertension, heart attack, aging and diabetes. Antioxidants are reducing agents and limit oxidative damage to biological structures by passivating free radicals (Aali *et al.*, 2018).

Scientific Classification of *Adiantum capillus-veneris* L.

Kingdom	:	Plantae
Division	:	Pteridophyta
Family	:	Adiantaceae
Genus	:	<i>Adiantum</i>
Species	:	<i>Adiantum capillus-veneris</i> L.
Common name	:	Maidenhair fern
Synonyms	:	<i>Adiantum michelii</i> <i>Adiantum modestum</i>
Myanmar name	:	Han-Tha-Yit
Plant used	:	The whole plant



Figure 1 Photograph (a) plant and (b) frond of *Adiantum capillus-veneris* L.

Materials and Methods

Collection and Preparation of the Sample

Adiantum capillus-veneris L. (Maidenhair Fern) was collected from Bahan Township, Yangon Region. Fresh fronds were washed, shade dried and then cut using clipper and stored in air-tight containers to prevent the moisture change and contamination. These samples were identified at Department of Botany, East Yangon University.

Phytochemical Investigation of *Adiantum capillus-veneris* L.

Phytochemical investigation of fern was carried out to determine the presence of phytochemicals such as alkaloids, α -amino acids, carbohydrates, flavonoids, glycosides, phenolic compounds, polyphenolic compound, reducing sugar, saponins, tannins and terpenoids (M, Tin Wa, 1972).

Extraction of Crude Extracts

100 g of dried powdered sample was percolated in 1000 mL of petroleum ether, ethyl acetate and 95 % ethanol at room temperature for one week and filtered. The residue was then percolated with different solvents for one week and filtered. The sample procedure was repeated twice. The combined filtrate was concentrated under vacuum rotatory evaporator. The dry filtrate was transferred to a weighed porcelain basin and evaporated to dryness on stem-bath to obtain different crude extracts. For water soluble extractable matter, dried powdered sample (100 g) was boiled with distilled water (100 mL) for 2 hours. The extract was then filtered and transferred to a weighed porcelain basin and evaporated to dryness on sand-bath. The different filtrate was placed in oven, maintained till constant weight at 100 °C. Some crude extracts were used for the determination of some antioxidant activity and total phenol content.

Determination of Antioxidant Activity of Crude Extracts from

Adiantum capillus- veneris L.

The antioxidant activity of 95 % ethanol, ethyl acetate and water extracts of crude sample were studied by using DPPH free radical scavenging assay.

Procedure

0.002 % DPPH solution was prepared in the brown colored bottle by dissolving (2 mg) of DPPH powder in the 100 mL of 95 % ethanol. Then it must be stored in the fridge for no longer than 24 hours. The stock solution (200 μ g/mL) of each crude extract was prepared by dissolving (2 mg) of respective crude extract in 10 mL of 95 % ethanol. This stock solution was two fold serially diluted with ethanol to obtain desired concentration of 200, 100, 50, 25 and 12.5 μ g/mL. 2 mg of ascorbic acid was thoroughly mixed with 10 mL of ethanol. The stock solution (200 μ g/mL) obtained was serially diluted with 95 % ethanol to obtain desired concentrations of 200, 100, 50, 25 and 12.5 μ g/mL. All these solutions were allowed to stand at room temperature for 30 min. Then, the absorbance was measured $\lambda_{\max}$ 517 nm and recorded on UV-Visible spectrophotometer. Absorbance of individual solution was measured in triplicate and % inhibition of each sample solution was calculated by using the following formula:

$$\begin{aligned} \% \text{ RSA} &= [(A_{\text{DPPH}} - (A_{\text{sample}} - A_{\text{Blank}})) / A_{\text{DPPH}}] \times 100 \\ \text{Where, \% RSA} &= \% \text{ radical scavenging activity of test sample} \\ A_{\text{DPPH}} &= \text{absorbance of control solution} \\ A_{\text{Sample}} &= \text{absorbance of test sample solution} \\ A_{\text{Blank}} &= \text{absorbance of blank solution} \end{aligned}$$

The antioxidant power can be expressed as 50 % inhibitory concentration (IC_{50}). The IC_{50} values were also calculated by linear regressive excel program. The standard deviation was also calculated by the following equation.

$$\text{Standard Deviation (SD)} = \sqrt{\frac{(\bar{X} - X_1)^2 + (\bar{X} - X_2)^2 + \dots + (\bar{X} - X_n)^2}{(n-1)}}$$

$$\begin{aligned}\bar{X} &= \text{Average \% inhibition} \\ X_1, X_2 \dots, X_n &= \% \text{ inhibition of test sample solution} \\ n &= \text{number of times}\end{aligned}$$

Determination of Total Phenol Content (TPC) of Crude Extracts of *Adiantum capillus-veneris* L. by Folin-Ciocalteu Method

One of the antioxidative factor, total phenol content (TPC), was measured spectrometrically, according to the Folin-Ciocalteu Method.

Procedure

The sample solution (1 mg/mL) was prepared by dissolving 10 mg of respective crude extract in 10 mL of distilled water and ethanol. The stock solution of standard gallic acid (1 mg/mL) was prepared by dissolving 10 mg of gallic acid in 10 mL of distilled water. This stock solution was serially two-fold diluted with distilled water to obtain the standard gallic acid solutions with the concentration of 500, 250, 125, 62.5, 31.25 and 15.625 µg/mL. 10 % Folin-Ciocalteu Reagent (FCR) reagent was prepared by diluting 1 mL of FCR in 10 mL of distilled water. 1 M Na₂CO₃ solution was prepared by dissolving 5.3 g of Na₂CO₃ in 50 mL of distilled water. All these solution were allowed to stand at room temperature for 30 min. Then, the absorbance at λ_{max} 635 nm and recorded on UV-Visible spectrophotometer. Absorbance of individual solution was measured in triplicate and % inhibition of each sample solution was calculated from linear regressive equation explored from standard gallic acid curve. TFC in the plant sample were expressed as µg gallic acid equivalent per milligram (µg GAE/ mg) of solution (Santhosh *et al.* , 2013).

Results and Discussion

Phytochemicals Investigation of *Adiantum capillus-veneris* L.

Phytochemical investigation was performed in order to know the different types of compounds present in the fern. These results are summarized in Table 1.

According to the results, alkaloids, α-amino acids, carbohydrates, flavonoids, glycosides, phenolic compounds, polyphenolic compound, reducing sugars, saponins, steroids, tannins and terpenoids were found to be present whereas starch was found to be absent in this fern.

Antioxidant Activity of Crude Extracts of *Adiantum capillus-veneris* L.

Free radical scavenging effects of ethyl acetate, ethanol and water extracts from fronds of *Adiantum capillus-veneris* L. were investigated by using DPPH assay method. This method is based on the capability of test sample to inhibit stable free radical (DPPH) that was followed by decrease in absorbance at λ_{max} 517 nm. Low absorbance value of test sample indicates high % inhibition against DPPH radical which in turn reveals high radical scavenging activity of that sample.

The absorbance and % inhibition of different concentrations of different extracts from the fern were tabulated in Table 2. The data were compared to that of standard ascorbic acid. For each sample, it was found that the higher the concentration of extract, the lower the absorbance of DPPH solution and the greater the radical scavenging activity of the extract. The plot of % inhibition versus concentration of different extracts was shown in Figure 2.

Table 1 Phytochemical Investigation of *Adiantum capillus-veneris* L.

No.	Test	Extracts	Test reagents	Observation	Result
1.	Alkaloids	1% HCl	Mayer's reagent Dragendorff's reagent Wagner's reagent	White ppt Orange ppt Yellow ppt	+ + +
2.	α -Amino acids	H ₂ O	Ninhydrin reagent	Violet colour	+
3.	Carbohydrates	H ₂ O	10 % α - Naphthol, conc : HCl	Red ring	+
4.	Flavonoids	EtOH	Mg ribbon, conc: H ₂ SO ₄	Pink colour	+
5.	Glycosides	H ₂ O	10 % lead acetate solution	White ppt	+
6.	Phenolic compounds	H ₂ O	FeCl ₃ solution	Green colour	+
7.	Poly phenolic compounds	H ₂ O	5 % FeCl ₃ , 1 % K ₃ Fe(CN) ₆	Blue colour	+
8.	Reducing sugars	Dil: H ₂ SO ₄	Benedict's solution	Brick-red ppt	+
9.	Saponins	H ₂ O	Distilled water	Frothing	+
10.	Starch	H ₂ O	I ₂ solution	No blackish blue colour	-
11.	Steroids	C ₆ H ₆	Acetic anhydride, conc: H ₂ SO ₄	Green colour	+
12.	Tannins	H ₂ O	10 % FeCl ₃ and dil: H ₂ SO ₄	Yellowish brown ppt	+
13.	Terpenoids	CHCl ₃	Acetic anhydride, conc: H ₂ SO ₄	Red colour	+

(+) = presence

(-) = absence

(ppt) = precipitate

Concentration of the sample necessary to decrease initial concentration of DPPH radical by 50 % (IC₅₀) under the experimental condition was also calculated in standard deviation equation. Therefore, the lower value of IC₅₀ indicates the higher antioxidant potential. Figure 3 show IC₅₀ values of crude extracts with standard ascorbic acid. According to the results, antioxidant activity of ethanol extract (IC₅₀ value of 62.76) is higher than the ascorbic acid (IC₅₀ value of 13.56) and lower than the ethyl acetate extract (IC₅₀ value of 133.90) and the water extract (IC₅₀ value of 167.85).

According to the Reynertson, 2007, IC₅₀ < 50 μ g/mL is very active, IC₅₀ > 200 μ g/mL is not active. Thus, it can be said that ethanol extract exhibits active antioxidant activity higher than ethyl acetate and water extracts which are moderately active in their antioxidant activities.

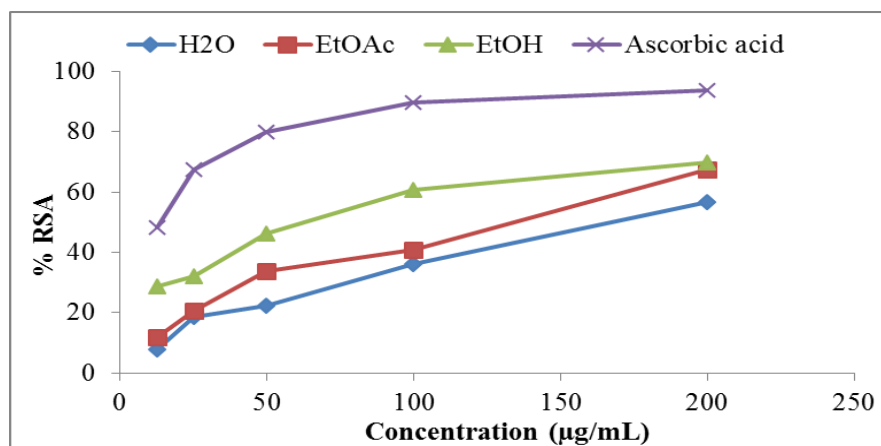


Figure 2. Percent radical scavenging activity (% RSA) vs. concentration of crude extracts of *Adiantum capillus-veneris* L. and standard ascorbic acid

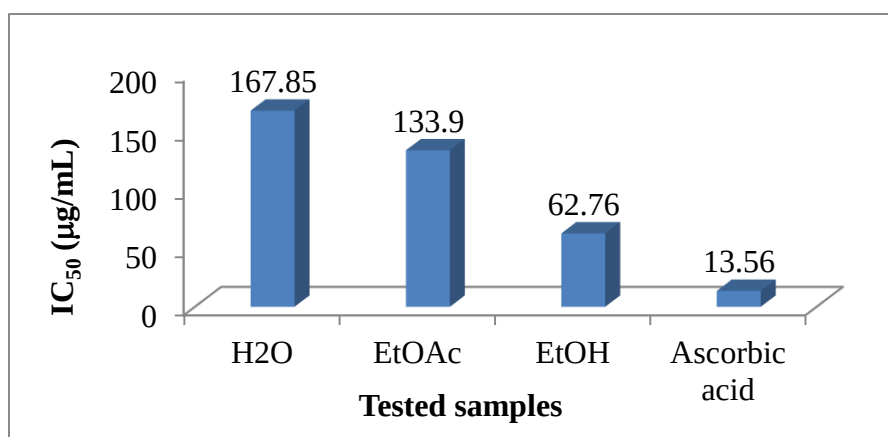


Figure 3. IC₅₀ values of crude extracts of *Adiantum capillus-veneris* L. and standard ascorbic acid

Total Phenol Contents of Crude Extracts of *Adiantum capillus-veneris* L.

Phenolic compounds are a diverse group of secondary metabolites and may contribute directly to antioxidant action. Folin-Ciocalteu (F.C) reagent was used to determine total polyphenol in sample extracts. This reagent oxidizes phenolates, under alkaline conditions, resulting in the production of blue complex molybdenum-tungsten which can be detected spectrophotometrically at λ_{max} 635 nm. F.C. reagent is employed routinely in studying phenolic antioxidants.

Gallic acid (3, 4, 5 – trihydroxy benzoic acid) was used to construct calibration curve for total phenol. Calibration curve of standard gallic acid was prepared by plotting absorbance versus various concentrations ranging from 500 to 15.625 µg/mL. As shown in table 3 and figure 4, gallic acid standard curve gave straight line. From the standard curve, it was observed that absorbance was found to be directly proportional to gallic acid concentration.

Table 2. Absorbance and % Inhibition of Different Extracts of *Adiantum capillus-veneris* L.

Extracts	Concentration (µg/mL)	Mean Absorbance ± SD	Mean % inhibition ± SD	IC ₅₀ (µg/mL)
H ₂ O	12.5	0.107±0.002	7.67±1.352	167.85
	25	0.098±0.006	18.61±4.927	
	50	0.094±0.003	22.42±2.227	
	100	0.083±0.004	35.99±3.350	
	200	0.082±0.003	56.64±2.341	
EtOAc	12.5	0.101±0.004	11.80±3.350	133.9
	25	0.092±0.006	20.65±4.874	
	50	0.081±0.002	33.63±1.770	
	100	0.074±0.006	41.00±5.032	
	200	0.062±0.003	67.55±2.704	
EtOH	12.5	0.090±0.006	28.61±5.109	62.76
	25	0.080±0.002	32.15±1.352	
	50	0.067±0.001	46.31±0.511	
	100	0.051±0.001	60.77±0.511	
	200	0.055±0.001	69.91±0.885	
Ascorbic acid	12.5	0.058±0.002	48.38±1.352	13.56
	25	0.037±0.002	67.55±1.352	
	50	0.023±0.001	79.94±0.511	
	100	0.012±0.002	89.68±1.352	
	200	0.007±0.001	93.67±0.417	

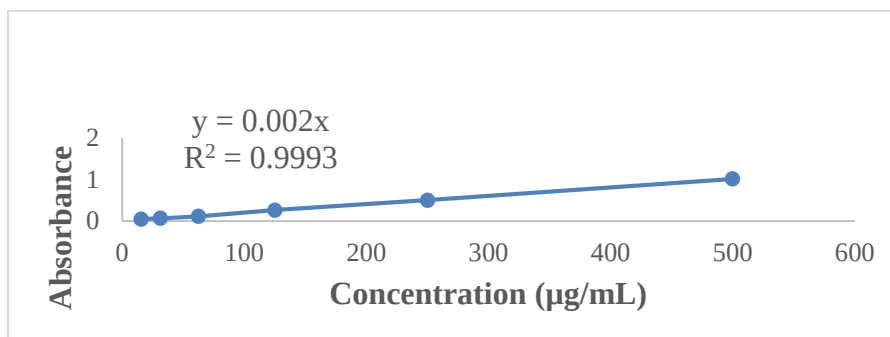
The total phenol contents (TPC) of water, ethyl acetate and ethanol extracts were determined in terms of µg of gallic acid equivalents per mg (µg GAE / mg) and the results were displayed in Table 3 and Figure 4.

For the maidenhair fern extracts, the phenol content was found to be in the order of ethanol > ethyl acetate > water. The phenol contents of the extracts in terms of gallic acid equivalent (the standard curve equation: $y = 0.002x$, $R^2 = 0.9993$) were calculated and found to be the highest for ethanol extract (260.00 ± 9.005) and the lowest for water extract (88.00 ± 4.444). So, ethanol is a good solvent for this fern as large amount of phenolic compounds are soluble in ethanol when compared with other extracts. This observation is consistent with the previous results of screening antioxidant activities of crude extracts.

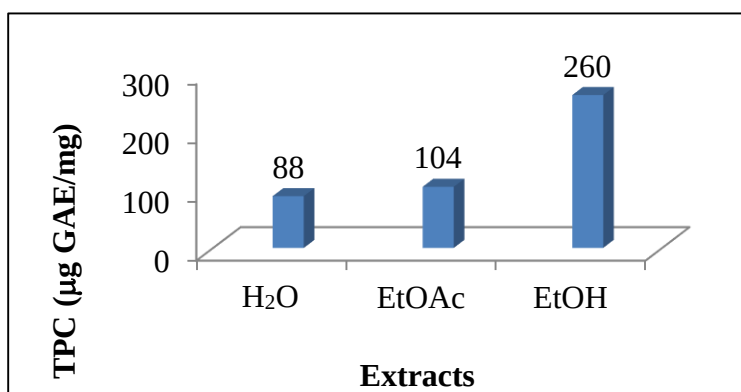
Phenolic compounds have redox properties, which allow them to act as antioxidants. As their free radical scavenging ability is facilitated by their hydroxyl groups, the total phenol concentration could be used as a basis for rapid screening of antioxidant activity. In this study, it can be assumed that the presence of the highest content of phenolic compounds in the ethanol extract is responsible for the most pronounced antioxidant activity of the extract.

Table 3. The Absorbance of Gallic Acid Standard Solution at $\lambda_{\max}$ 635 nm

Sr No.	Concentration ($\mu\text{g/mL}$)	Absorbance
1.	500	1.009
2.	250	0.498
3.	125	0.260
4.	62.5	0.111
5.	31.25	0.063
6.	15.625	0.045

**Figure 4. A plot of absorbance vs. concentration of standard gallic acid****Table 4. Total Phenol Content (TPC) of Crude Extracts of *Adiantum capillus-veneris* L. by Folin-Ciocalteu Method**

Extracts	Mean absorbance $\pm$ SD	TPC ($\mu\text{g GAE/mg} \pm$ SD)
H ₂ O	0.176 $\pm$ 0.009	88.00 $\pm$ 4.444
EtOAc	0.208 $\pm$ 0.014	104.00 $\pm$ 7.000
EtOH	0.520 $\pm$ 0.018	260.00 $\pm$ 9.005

**Figure 5. Histogram of total phenol content of crude extracts of *Adiantum capillus-veneris* L.**

Conclusion

The phytochemical investigation of the plant sample revealed the presence of alkaloids, α -amino acids, carbohydrates, flavonoids, glycosides, phenolic compounds, poly phenolic compounds, reducing sugars, saponins, steroids, tannin and terpenoids whereas starch was found to be absent in this sample. Antioxidant activities of crude extracts were investigated by using DPPH assay in which ascorbic acid was used as a standard antioxidant. On comparison of IC₅₀ values, the highest antioxidant activity was observed in ethanol extract with IC₅₀ value of 62.76 μ g/mL and the lowest for water extract with IC₅₀ value of 167.85 μ g/mL. Total phenol contents of these extracts were measured by Folin-Ciocalteu method. From the calibration curve of standard gallic acid solutions, total phenol contents of ethanol extract was found to be the highest (260.00 $\pm$ 9.005 μ g GAE/mg) followed by ethyl acetate (104.00 $\pm$ 7.000 μ g GAE/mg) and water extract (88.00 $\pm$ 4.444 μ g GAE/mg). So, ethanol is a good solvent for extraction of phenolic compounds which are responsible for the most pronounced antioxidant activity.

Acknowledgements

First of all, I wish to express my deepest appreciation and special thanks Rector Dr Nay Win Oo, Pro-Rectors Dr Aye Aye Ko, Dr Wah Wah Lwin, Dr Thidar Aung, East Yangon University for their kind permission to submit this paper. I would like to express my sincerest thanks to Professor and Head Dr Myo Myo Myat, Professors Dr Than Than Oo and Dr Myint Myint May, Department of Chemistry, East Yangon University for their encouragement and advice. I am very thankful to my teachers Associate Professor Dr Myint Aung, Department of Chemistry, West Yangon University and Dr Thiri San, Lecturer, Department of Chemistry, East Yangon University, for their kind advices and giving valuable knowledge.

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ENZYMATIC PROPERTIES OF α -AMYLASE FROM VIGNA RADIATA L. (PE-TE-SEIN)

Shoon Leii Khin*

Abstract

Alpha-amylase(α -amylase) is an enzyme (EC 3.2.1.1) that hydrolyses alpha bonds of large, alpha-linked polysaccharides, such as starch and glycogen, yielding shorter chains thereof, dextrin and maltose. It is the major form of amylase found in humans, plants and other mammals. In this research firstly, α -amylase was prepared from germinated mung bean with acetate buffer solution during 9 days periods. α -Amylase was confirmed by iodine solution test. For estimation of maltose, colorimetric method with 3, 5-dinitrosalicylic acid (DNS reagent) was used. The wavelength of maximum absorption was 522 nm. Maximum α -amylase activity was found to be $0.673 \mu\text{mol min}^{-1} \text{mL}^{-1}$ in third day of germination period, optimum pH at 6.4 and temperature at 55°C . Alpha-amylase activity was determined by Michaelis-Menten equation. The values of K_m and $V_{\max}$ from experimental results were calculated by using Lineweaver-Burk, Eadie-Hofstee, Hanes-Wilkinson and Eisenthal-Cornish Bowden equation. These values were compared with those obtained from graphical method. The K_m and $V_{\max}$ values were found to be $0.60 \times 10^{-2} \text{ g mL}^{-1}$ and $2.50 \times 10^{-4} \text{ M min}^{-1}$ respectively. The reaction order for α -amylase was calculated to be 1.02 proving that the order of reaction is first order.

Keywords: Mung bean germ, α -amylase, maltose, 3,5-dinitrosalicylic acid, K_m , $V_{\max}$

Introduction

Mung bean is an annual crop, cultivated mostly in rotation with cereals. Seeds are small, thin and cylindrical. Mung bean also known as green gram or moong bean is a legume that is staple in many Asian countries and is used to cook both sweet and savory dishes. It is contained higher levels of folate, vitamin C, potassium, magnesium, phosphorus and anti-oxidants than the unsprouted beans. Mung bean sprouts are used in preparation of various dishes like stir fry, salads, soups, curries and noodles, and in a wide range of traditional Asian foods. Starch is commonly derived from grains or seeds (wheat, corn, rice and barley), tubers (potato) and roots (cassava) (Buleon *et al.*, 1998). The rate of enzymatic reactions depends on pH, temperature, reaction time, enzyme concentration and substrate concentration. It has been found that α -amylase is active in wide ranges of pH and temperature (Pandey *et al.*, 2000). The aim of this research was to study the preparation and characterization of from *Vigna radiata* L. (Pe-te-sein).



Figure 1 Seeds of Mung bean and germinated Mung bean

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Materials and Methods

Sample Collection

Vigna radiata L. (Mung bean) sample was collected from Thiri Mingalar market, Yangon Region.

Sample Preparation and Extraction of α -Amylase from Germinated Mung Bean

The seed of mung bean 50 g was soaked in a cup of 200 mL of water for overnight. Bleach paper was placed on bottom of colander. Seeds were spread over paper and water was poured thoroughly 2-3 times a day. Seeds were covered with a towel after watering and strong away. The sprouts were not exposed to light when they have grown or the leave will turn green at day 1. Similarly, the mung bean was germinated at day 2, 3, 4, 5, 6, 7, 8 and 9.

After day 1 germination, mung bean germ (25 g) was taken and mixed with 100 mL of mixture of 0.1M NaCl solution and 0.1M acetate buffer (pH 5.6) (1:1). The mixture was blended in a blender for 10 min at room temperature and then filtered by using thin cotton cloth. Filtrate was centrifuged at 3000 rpm for 10 min. Eventually, crude enzyme extract was obtained. Similarly, same procedure was carried out for day 2, 3, 4, 5, 6, 7, 8 and 9. The prepared enzyme solutions were kept in refrigerator at 4°C.

Confirmation of α -Amylase by Iodine Solution Test

A test tube containing 1 mL of enzyme solution was labeled as tube A and another tube containing 1 mL of distilled water was labeled as tube B for blank solution. 5 mL of each of 1% starch solution was added into each test tube A and B, then the content was mixed and then heated on boiling water bath at 40°C for 10 min. After this, 1 mL each of iodine solution was added into test tube A and B.

Determination of α -Amylase Activity from Germinated Mung Bean

The absorption spectrum of 3-amino-5-nitrosalicylic acid was recorded in the range of 450-650 nm. The wavelength of maximum absorption various concentration was found to be 522 nm. Construction of calibration curve was carried out by using various concentration of standard maltose solution. Specific activity was calculated by using enzyme activity. Effects of pH, temperature, reaction time and substrate concentrations on enzyme activity were determined by spectrophotometric method. Enzyme kinetic parameters (K_m , V_{max}) and reaction order of enzyme catalyzed reactions were determined.

Results and Discussion

Wavelength of Maximum Absorption of 3-amino-5-nitrosalicylic acid by DNS Method

The DNS method is a colorimetric technique that consists of a redox reaction between the 3, 5-dinitrosalicylic acid and the reducing sugars present in the sample. The 3, 5-dinitrosalicylic acid (yellow) is reduced to 3-amino-5-nitrosalicylic acid (red-brown) while, in the simplest instances, the aldehyde groups appear to be oxidized to carboxyl group which can be quantified by spectrophotometry at 540 nm. Maltose can be oxidized to the carboxyl group by mild oxidizing agents according to its reducing power (Miller, 1959). In the present research, the absorption spectrum of 3-amino-5-nitrosalicylic acid was recorded in the range of 450-650 nm. The wavelength of maximum absorption was found to be 522 nm as described in Figure 2. Thus, the absorbance of 3-amino-5-nitrosalicylic acid formed from reduction by maltose was measured at this wavelength.

Calibration Curve for Standard Maltose Solution

The standard curve for maltose is usually constructed using 3, 5-dinitro salicylic acid (DNS) as the reagent. In this study, the absorbance values at 522 nm were obtained for different maltose concentrations by using a UV-visible spectrophotometer. It was found that the nature of the plot of absorbance vs. concentrations of maltose was a straight line passing through the origin showing that Beer's law was obeyed as shown in Table 1 and Figure 3.

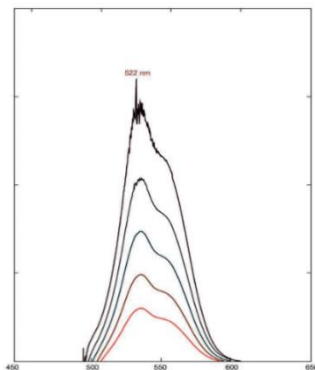


Figure 2. Wavelength of maximum absorption of 3-amino-5-nitrosalicylic acid by DNS method

Table 1. Relationship between Absorbance at 522 nm and Concentration of Standard Maltose Solution

Maltose concentration (mM)	Absorbance (nm)
0.5	0.307
1.0	0.588
1.5	0.839
2.0	1.103
2.5	1.298

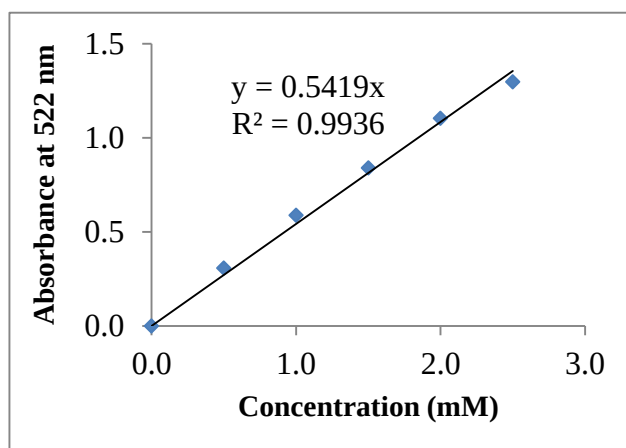


Figure 3. Standard calibration curve for determination of maltose

Extraction of α-Amylase from Germinated Mung Bean

Crude enzyme solutions were extracted during the various germinated days (1 to 9 days) and stored in refrigerator at 4°C (Figure 4).



Confirmation of α-Amylase by Iodine Solution Test

In this research, the mixture of starch and distilled water gave blue-black color with iodine solution for blank solution. Starch and enzyme solutions gave no color with iodine solution. Hence, the presence of α-amylase was proved by iodine solution test (Chavan and Wadatkar, 2014).

Variation of α-Amylase Activity with Germination of Day

In this study, α-amylase activity of mung bean during germination period are presented in Table 2 and Figure 5. During the germination period, the maximum amylase activity was found at third day (0.673μmol min⁻¹ mL⁻¹). Amylase activity was increased from day 1 to day 3 of germination period and decreased from day 4 to day 9 of germination period.

Table 2 Relationship between Day of Germination and α-Amylase Activity

Germination day	α-Amylase activity (μmol min ⁻¹ mL ⁻¹)
1	0.356
2	0.520
3	0.673
4	0.559
5	0.369
6	0.349
7	0.324
8	0.321
9	0.316

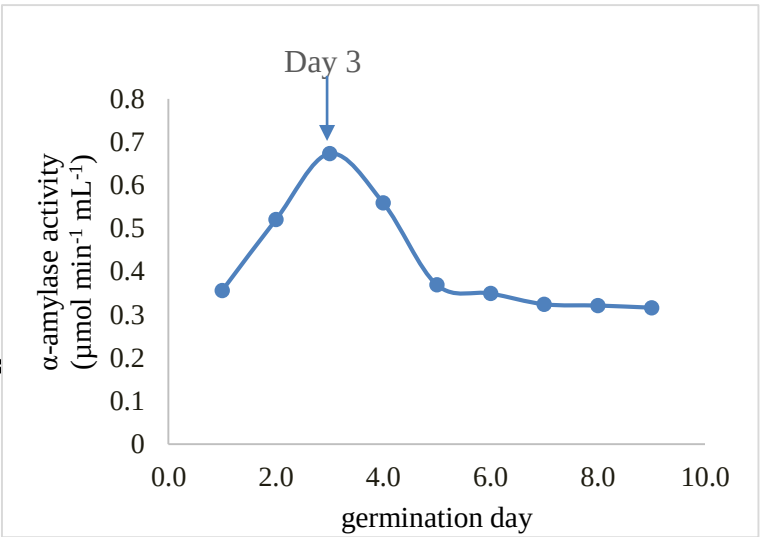


Figure 5. Variation of α-amylase activity with germination day

Effect of pH on the α -Amylase Activity

Optimum pH is a critical factor for the stability of enzyme produced. Enzymes are pH sensitive and care must be taken to control the pH of the production process (Sundarram and Murthy, 2014). In this research, the effect of pH on enzyme activity was determined by using sodium phosphate buffer solution at pH range 6.0 to 7.4. The relationship between enzyme activity and pH of the solution was presented in Table 3 and Figure 6. At the optimum pH 6.4, α -amylase activity was found to be $1.103 \mu\text{mol min}^{-1} \text{mL}^{-1}$ with starch as substrate.

Table 3 Relationship between α -Amylase Activity and pH of the Solution

Sodium Phosphate buffers pH	α -Amylase activity ($\mu\text{mol min}^{-1} \text{mL}^{-1}$)
6.0	0.523
6.2	0.788
6.4	1.103
6.6	0.874
6.8	0.766
7.0	0.726
7.2	0.623
7.4	0.592

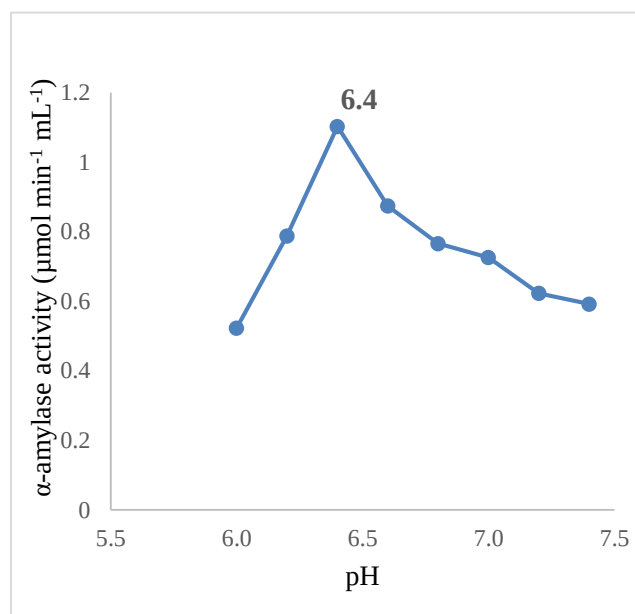


Figure 6 Plot of α -Amylase activity as a function of pH of the solution

Effect of Temperature on the α -Amylase Activity

The enzyme activity increases with increase in temperature till it reaches the optimum. With further increase in temperature the enzyme activity decreases (Sundarram and Murthy, 2014). Most animal enzymes rapidly become denatured at temperature above 40°C . Most enzyme determinations are carried out some below that temperature. Some enzymes lose their activity when frozen. In this research, the effect of temperature for α -amylase activity was determined at temperature range of 30°C to 70°C . The optimum temperature was obtained to be 55°C in sodium phosphate buffer at pH 6.4 and α -amylase activity was found to be $0.443 \mu\text{mol min}^{-1} \text{mL}^{-1}$. It was found that the activity of α -amylase increased from 30°C to 55°C and then decreased from 55°C to 70°C as shown in Table 4 and Figure 7.

Effect of Reaction Time on α -Amylase Catalyzed Reaction

The factor of pH, temperature, enzyme concentration, substrate concentration and reaction time influence the rate of enzyme-catalyzed reaction, reaction time is the most outstanding factor (Das, 1982). In this work, the action of the α -amylase on soluble starch was studied in sodium phosphate buffer at pH 6.4. The velocity at various reaction times of 5, 10, 15, 20, 25 and 30 min were determined by DNS method. The velocity of α -amylase reaction as a function of reaction time was shown in Table 5 and Figure 8. At the beginning of the reaction (during 5 min), the

reaction is very fast. After 10 min, velocity decreased steadily. Hence, reaction time of 10 min was used for measurement of initial velocity in enzyme kinetic.

Table 4. Relationship between α -Amylase Activity and Temperature of the Solution

Temperature (°C)	α -Amylase activity ($\mu\text{mol min}^{-1} \text{mL}^{-1}$)
30	0.192
35	0.234
40	0.287
45	0.373
50	0.390
55	0.443
60	0.387
65	0.337
70	0.286

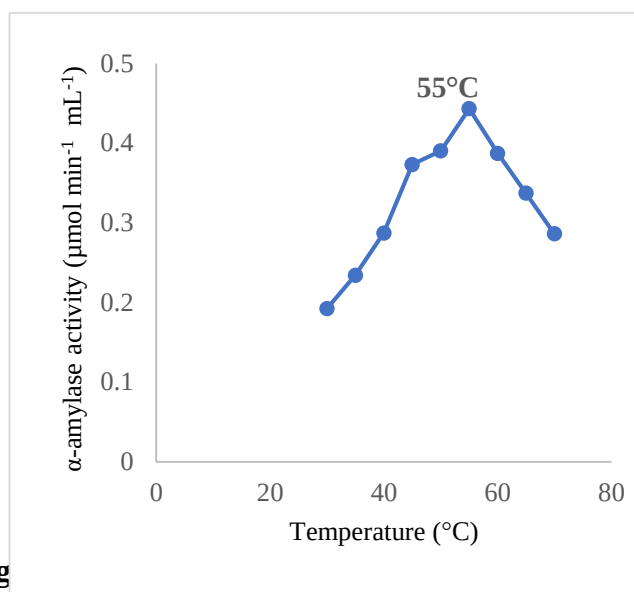


Fig
of temperature of the solution

Table 5. Relationship between Reaction time and Velocity of α -Amylase Catalyzed Reaction

Reaction time (min)	Velocity $\times 10^4$ (M min^{-1})
5	0.376
10	0.253
15	0.205
20	0.187
25	0.169
30	0.160

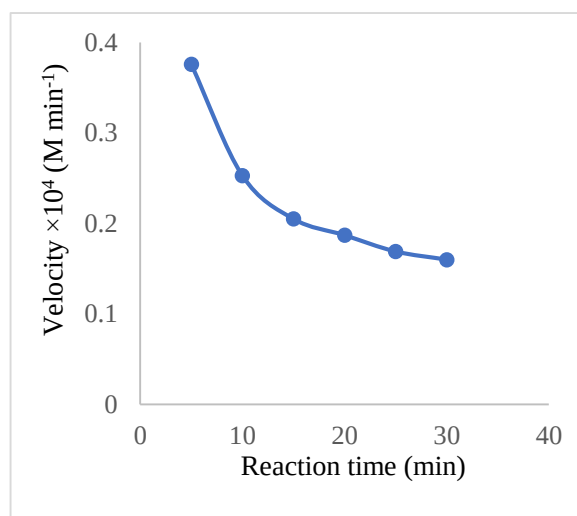


Figure 8. Plot of velocity of α -amylase catalyzed reaction as a function of reaction time

Effects of Substrate Concentration on α -Amylase Catalyzed Reaction

The determination of optimum substrate concentration for α -amylase, solution of soluble starch in the concentration ranges from 0.5 % to 3.0 % was used. Justifying that on the substrate concentration was increased above 0.1 %, rate of reaction increased progressively up to 1.5 %. When, the concentration increased above 1.5 %, the rate of reaction remained constant suggesting that α -amylase obtained from germinated mung bean followed by Michaelis-Menten equation. Hence optimum substrate concentration was found to be 1.5 %, as in graph justifying that, at this concentration enzyme retained saturated with substrate for 10 min and rate of reaction was maximum at this concentration. After this point, increase in substrate concentration will not increase the velocity. This is represented graphically in Figure 9. This point on the graph is designated $V_{\max}$. From Michaelis-Menten plot, K_m and $V_{\max}$ values were found to be $0.60 \times 10^{-2} \text{ g mL}^{-1}$ and $2.50 \times 10^{-4} \text{ M min}^{-1}$ respectively. The velocities of enzyme reaction measured at different levels of substrate concentration and their reciprocal values are shown in Table 6. In this work, statistical methods were used to get $V_{\max}$ and K_m from experimental results. These values are shown in Table 7 in comparison with $V_{\max}$ and K_m values obtained by Lineweaver-Burk (Figure 10), Eadie-Hofstee (Figure 11), Hanes-Wilkinson (Figure 12), Eisenthal-Cornish Bowden plots (Figure 13).

Table 6. Relationship between Initial Starch Concentration and Velocity of α -Amylase Catalyzed Reaction

No.	$[S] \times 10^2$ (g mL ⁻¹)	$-[S] \times 10^2$ (g mL ⁻¹)	$1/[S] \times 10^{-2}$ (g ⁻¹ mL)	$V \times 10^4$ (M min ⁻¹)	$1/V \times 10^{-4}$ (M ⁻¹ min)	$V/[S] \times 10^2$ (M min ⁻¹ g ⁻¹ mL)	$[S]/V \times 10^{-2}$ (g mL ⁻¹ M ⁻¹ min)
1.	0.500	- 0.500	2.000	1.122	0.891	2.244	0.446
2.	1.000	- 1.000	1.000	1.653	0.605	1.653	0.605
3.	1.500	- 1.500	0.667	1.962	0.510	1.308	0.765
4.	2.000	- 2.000	0.500	2.214	0.452	1.107	0.903
5.	2.500	- 2.500	0.400	2.356	0.424	0.942	1.061
6.	3.000	- 3.000	0.333	2.502	0.400	0.834	1.199

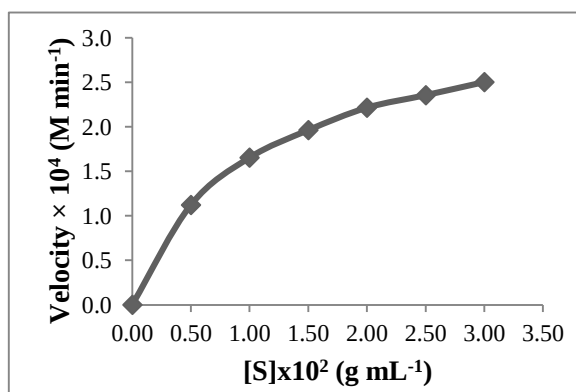


Figure 9. Michaelis-Menten plotted used for graphic evaluation of $V_{\max}$ and K_m for α -amylase

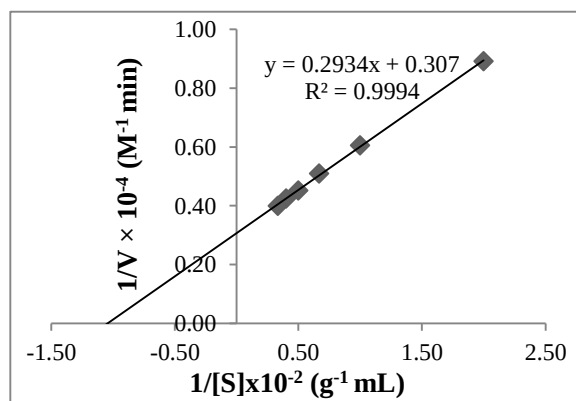


Figure 10. Lineweaver-Burk plot of $1/[V]$ vs. $1/[S]$ used for graphic evaluation of $V_{\max}$ and K_m for α -amylase

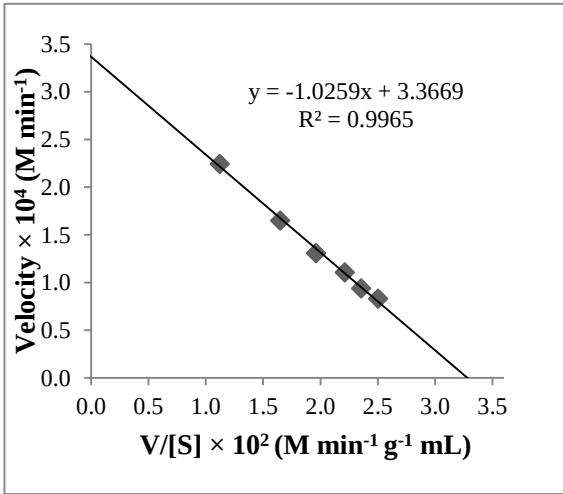


Figure 11. Eadie-Hofstee plot of velocity vs. $V/[S]$ used for graphic evaluation of $V_{\max}$ and K_m for α -amylase

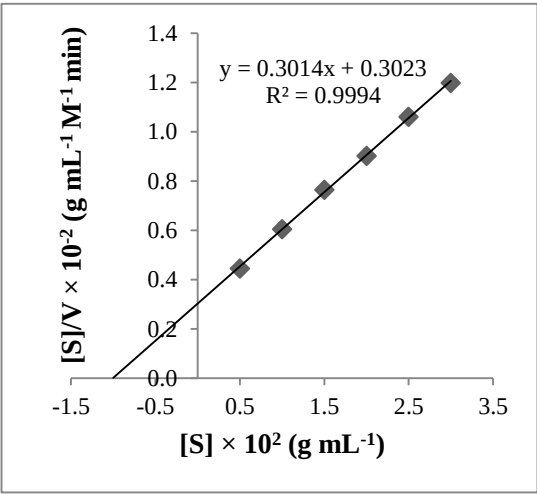


Figure 12. Hanes-Wilkinson plot of $[S]/V$ vs. $[S]$ used for graphic evaluation of $V_{\max}$ and K_m for α -amylase

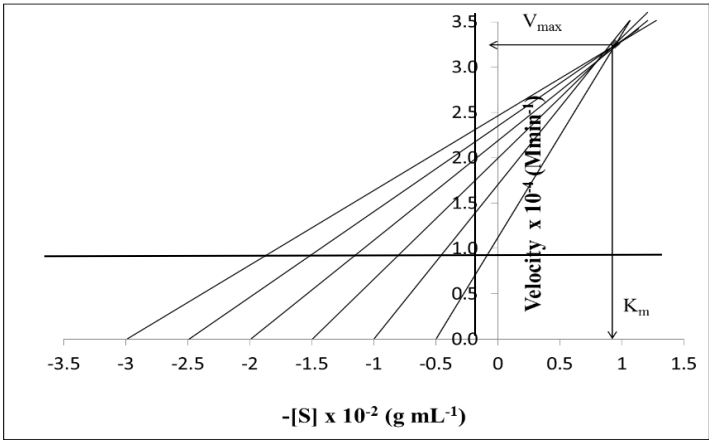


Figure 13. Eisenthal-Cornish Bowden plot used for graphic evaluation of $V_{\max}$ and K_m for α -amylase

Table 7. Comparison of K_m and $V_{\max}$ Values of α -Amylase Calculated from Different Methods

No.	Method	Linear regression		Plot	
		$K_m \times 10^2$ (g mL ⁻¹)	$V_{\max} \times 10^4$ (M min ⁻¹)	$K_m \times 10^2$ (g mL ⁻¹)	$V_{\max} \times 10^4$ (M min ⁻¹)
1	Eisenthal-Cornish Bowden	-	-	0.95	3.23
2	Lineweaver-Burk	0.96	3.25	1.11	3.55
3	Eadie-Hostee	0.97	3.28	1.01	3.30
4	Hanes-Wilkison	1.00	3.32	1.00	3.33
5	Michaelis-Menten	-	-	0.60	2.50

Reaction Order (n) for α -Amylase Catalyzed Reaction

The order of a chemical reaction with respect to the individual components is defined as the power of the component concentration included in the rate equation (Christensen and Palmer, 1974). Depending on the substrate concentrations, the kinetics of an enzyme-catalyzed reaction may be described by the first-order rate equation (Bergmeyer, 1983). In the present work, K_m and n values were determined from the plot of $\text{Log } V/V_{\max} - V$ vs. $\text{Log } [S]$ using linear regression method as shown in Table 8 and Figure 14. The reaction order (n) for α -amylase was calculated to be 1.02 proving that the reaction order is first order. The K_m was observed to be $0.865 \times 10^{-2} \text{ g mL}^{-1}$.

Table 8. Reaction Order (n) and K_m Value for α -Amylase Catalyzed Reaction

No.	$[S] \times 10^2$ (g mL^{-1})	$\text{Log } [S]$	$V \times 10^4$ (M min^{-1})	$\text{Log } V/V_{\max} - V$
1.	0.5	- 2.301	1.122	-0.277
2.	1.0	- 2.000	1.653	0.016
3.	1.5	- 1.824	1.962	0.184
4.	2.0	- 1.699	2.214	0.331
5.	2.5	- 1.602	2.356	0.422
6.	3.0	- 1.523	2.502	0.526

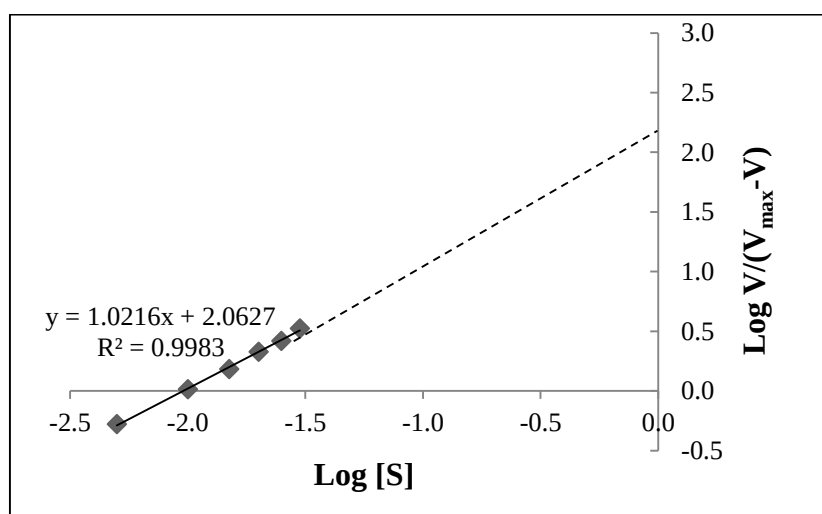


Figure 14 Plot of $\log V/(V_{\max} - V)$ as function of $\log [S]$ for α -amylase catalyzed reaction

Conclusion

α -Amylase is the enzyme which hydrolyzes starch and hence have considerable commercial interest. In the present study, α -amylase is extracted from germinated mung bean by extraction with aqueous acetate buffer solution. Confirmatory tests for of α -amylase activity in the solution was carried out by using iodine staining method. After determining the wavelength of maximum absorption of the 3-amino-5-nitrosalicylic acid formed in DNS method, standard calibration curve was constructed using standard maltose solution and absorbance was measured at 522 nm. The curve was linear and passed the origin, and therefore Beer's-Law was obeyed. Mung bean seed was germinated in room temperature for day 1 to day 9 periods. The maximum activity of α -amylase ($0.673 \mu\text{mol min}^{-1} \text{mL}^{-1}$) was found at third day of germination. α -Amylase activity from germinated mung bean having optimum pH at 6.4 and optimum temperature at 55°C . The α -amylase extracts from germinated mung bean following Michaelis-Menten equation. From Michaelis-Menten plot, K_m and $V_{\max}$ values were found to be $0.60 \times 10^{-2} \text{ g mL}^{-1}$ and $2.50 \times 10^{-4} \text{ M min}^{-1}$ respectively. The values of K_m and $V_{\max}$ from experimental results were calculated by using Lineweaver-Burk, Eadie-Hofstee, Hanes-Wilkinson, Eisenthal-Cornish Bowden. These values of K_m and $V_{\max}$ were compared with Michaelis-Menten plot from graphical method. The reaction order for α -amylase was calculated to be 1.02 proving that the order of reaction is first order. It can be concluded that mung bean is a good source of α -amylase and this enzyme could find promising application of hydrolysis of starch.

Acknowledgements

First of all, I wish to express my deepest appreciation and special thanks to Rector Dr Nay Win Oo, Pro-Rectors Dr Aye Aye Ko, Dr Wah Wah Lwin and Dr Thida Aung, East Yangon University for their kind permission to submit this paper. I would like to express my sincere thanks to Professor Dr Myo Myo Myat, Professor and Head, Professor Dr Than Than Oo and Professor Dr Myint Myint May, Department of Chemistry, for their encouragement and advice. I also thank to my teacher Dr Yin Min, Professor and Head, Department of Chemistry, Maubin University who aided me with her strength, for her understanding, encouraging during my study.

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REMOVAL OF METHYLENE BLUE SOLUTION BY USING STEM AND PEEL CHAR OF BANANA

San Dar Win¹, Htay Oo Kyaing²

Abstract

The present work is concerned with the removal of methylene blue in an aqueous solution by using banana stem and banana peel char samples as adsorbent materials. The physicochemical properties of banana stem and banana peel char were determined by conventional method. The adsorption parameters of banana stem and banana peel char such as initial concentration, contact time and dosage of adsorbent on methylene blue solution were studied by UV visible spectrophotometric method. These adsorption behaviors of adsorbent were determined by Scanning Electron Microscope (SEM) technique. The removal of methylene blue solution using banana stem and banana peel char samples were found to follow the Langmuir and Freundlich model equations. By using these model equations, adsorption parameters were evaluated.

Keywords: Methylene blue, adsorption, UV visible spectrophotometric method, banana stem and peel char

Introduction

A large number of chemicals are found in the environment containing toxic substances with rapid increase in populations and growth of industrialization in the country, quality of both surface and ground water changes day by day (Tan *et al.*, 2008). Dyes are widely used in textile, paper, plastic, food, printing, pharmaceutical and cosmetic industries. Dyes are highly coloured compounds which are non-biodegradable's persist in water, retards photosynthetic activity, inhibit growth of aquatic biota and decrease recreation value of stream. The wastes coming from these industries can affect on our atmosphere causing from these industries can affect our atmosphere causing pollution (Tahir *et al.*, 2008).

The process of adsorption has an edge over the other methods. It is potential alternative to conventional treatment techniques for the removal of pollutants from the contaminated effluent even from diluted solution (Kalderis *et al.*, 2008). Activated carbon is the most widely used adsorbent as it shows excellent adsorption efficiency. The high adsorption capacity of activated carbon is associated with internal porosity and other properties such as high surface area, pore volume, and pore size distribution. In this situation, natural raw materials are a possible biosorbents that could provide a successful solution. Evaluation of waste biomass as adsorbent is getting increase all over the world as it is renewable, widely available, cheap, environmental (Rengarag *et al.*, 1996). In this present work, the ability of a char obtained by banana stem and peel to remove cationic dye, namely methylene blue from synthetic aqueous solutions by adsorption, was considered. The effect of different experimental parameters such as initial concentration, contact time and dosage (adsorbent mass) on the amount of colour removal were investigated and the experimental sorption equilibrium data were then analyzed using Langmuir and Freundlich equations (Hirasaki, 1993). In the Langmuir model, the adsorbent surface is considered to possess a number of active interaction sites for adsorption. Langmuir of derived a relation between adsorbed material and its equilibrium concentration. An important assumption of Langmuir theory

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is the formation of a monolayer. Because of monolayer formation saturation in adsorption would reach at higher equilibrium concentration of the adsorbate.

$$(C_e / x/m) = (1/bX_m) + (C_e/ X_m)$$

Where, b is the adsorption coefficient or Langmuir constants, X_m is the monolayer capacity, x/m is the amount of dye required to form monolayer over the surface of adsorbent and C_e is the equilibrium concentration.

In the Freundlich model, multilayer formation has been observed when molecules are adsorbed through weak forces (long range forces, normally under physical adsorption) due to cohesive forces exerted by the molecules of the adsorbate. At high pressure multilayer adsorption takes place. However, modified Freundlich isotherm is essential for the adsorption of heterogeneous system (Nimkar and Chavan, 2014).

$$\log x/ m = \log K + 1/n \log C_e$$

Where, x/m is the amount adsorbed per unit, more of the adsorbent, C_e is the equilibrium concentration, and $1/n$ and K are constants. These parameters give a measure of adsorbing capacity of the adsorbent and intensity of adsorption respectively.

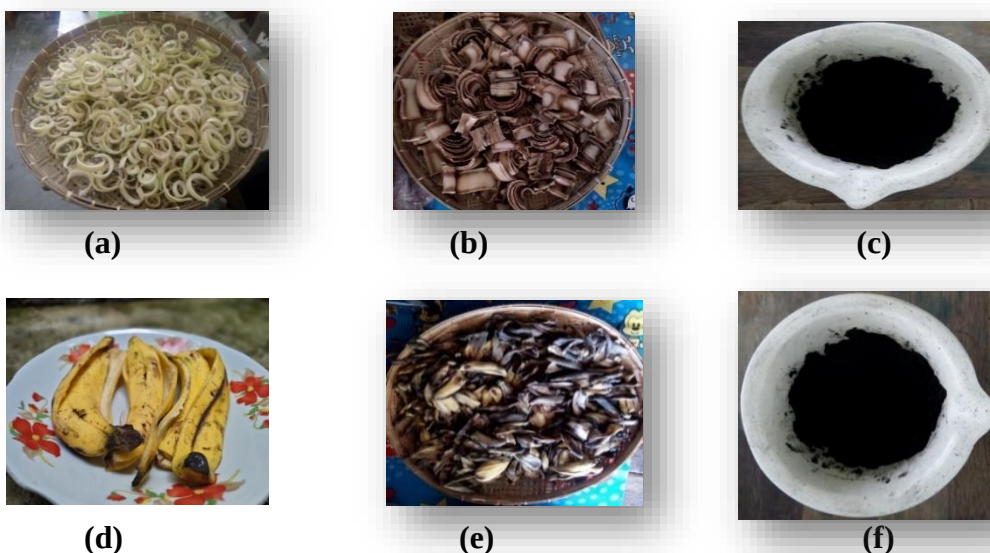


Figure 1. The photographs of (a) Banana stem, (b) Small pieces of banana stem, (c) Banana stem char, (d) Banana peel, (e) Small pieces of banana peel, (f) Banana peel char

Materials and Methods

Preparation of Sample

The samples (banana stem and peel) were collected from Nyaung Ni village, Thongwa Township, Yangon Region. The samples were washed, cut, dried and placed in an oven. Dried sample then was ground and being stored separately in air tight bottle for further use. Pieces of banana stem and peel were placed into each tin can with a lid of aluminium foil. The lid of tin can should have a vent holes through air flow to the inside of the tin can should be limited throughout this process. Then, tin can is placed on an open fire at 600 °C for 1 to 2 hrs to make char.

Physicochemical Properties of Banana Stem and Peel Char Samples

Determination of moisture content

Each sample 5 g was placed in a crucible and heated in an oven at 100 °C for 4 hrs. It was cooled in a desiccator and weighed. The process of heating, cooling and weighing was repeated for each sample until a constant weight obtained.

Determination of ash content

Each sample 5 g was placed in a crucible and it was then placed in a furnace. The sample is heated completely at 600 °C for 4 hrs and was cooled in a desiccator at room temperature and reweighed.

Determination of pH

Each sample 1 g was placed in a beaker and deionized distilled water 100 mL was added into it. Then, the contents were boiled for 3 minutes and cooled at room temperature and pH of the sample was determined by pH meter.

Determination of bulk density

A clean dry 10 mL graduated cylinder was weighed. It was filled with the dry sample to 10 mL mark and reweighed. The cylinder was tapped gently until there was no more reduction in volume.

Preparation of methylene blue (Stock solution)

The methylene blue solution 1000 mL was prepared by dissolving 0.01 g of methylene blue in distilled water. Stock dye solution of methylene blue containing 10 ppm of adsorbate were accurately prepared. In the preparation of diluted dye solutions, (concentrations ranging 0.312 ppm to 10 ppm) distilled water was used as the diluents. The calibration curve was used to evaluate the residual colour against a series of standard dye concentration.

Removal of Methylene Blue using Banana Stem and Peel Char Samples

Effect of concentration on the removal of methylene blue using banana stem and peel char samples

The sorption of methylene blue on banana stem and peel char samples were studied at various initial methylene blue concentrations. Each 100 mL of methylene blue solution was added to separate conical flask and adjusted to pH 7. Then, 2.5 g of banana stem and peel char samples were added into each conical flask and were stirred in shaker for 1 hr. Then, the solution was removed from the samples by filtration. The residual filtrates were analyzed for methylene blue concentration by using UV visible spectrophotometer at 665 nm.

Effects of contact time on the removal of methylene blue using banana stem and peel char samples

The sorption of methylene blue on banana stem and peel char samples were studied at different contact times. Each 100 mL of methylene blue solution 10 ppm was added to separate conical flask and adjusted to pH 7. Then, 2.5 g of banana stem and peel char samples were added into each conical flask and stirred in shaker for interval time. Then, the solution was removed from the samples by filtration. The residual filtrates were determined by using UV visible spectrophotometer at 665 nm.

Effects of adsorbent dosage on the removal of methylene blue using banana stem and peel char samples

Effect of adsorbent dosage on sorption of methylene blue on banana stem and peel char samples were studied by different weights of banana stem and peel char samples. Each 100 mL of methylene blue solution 10 ppm was added to separate conical flask and adjusted to pH 7. Then, 0.5 g of banana stem and peel char samples were added into each conical flask and were stirred in shaker for 1 hr. Then, the solution was removed from the samples by filtration. The residual filtrates were analyzed for methylene blue concentration by using UV visible spectrophotometer at 665 nm.

SEM Analysis

Before and after methylene blue solution sorbed samples were determined by the scanning electron micrographs. The surface morphology of the sample was characterized with a scanning microscope at the accelerating voltage of 12 KV. SEM micrographs of banana stem and peel char were found that there were many uniform flake like nature on the surface of banana stem and peel char.

Results and Discussion

Physicochemical Properties of Banana Stem and Peel Char Samples

The application and functions of biochars are highly depending on their physicochemical properties. Therefore, it is very important to characterize their physicochemical properties before use. In the present work, physicochemical properties such as moisture content, ash content, bulk density and pH content of banana stem and peel char samples were studied. Moisture content and ash content were determined by oven drying method. Table 1 shows the physicochemical properties of banana stem and peel char samples. It was found that the moisture content of 7.6 % banana stem char was greater than that of banana peel char 6.8 %. Therefore, banana stem char is more porous structure and has an ability to take up more moisture. Ash of all samples may be attributed to nonvolatile materials. The ash content can be observed to show for banana stem char and banana peel char which are 10.023 % and 9.780 % respectively. The pH value of banana stem char 6.9 is greater than that of banana peel char 6.5. The bulk density of banana stem char 1.34 g cm⁻³ is greater than that of banana peel char 0.85 g cm⁻³.

Table 1. Physicochemical Properties of Banana Stem and Peel Char Samples

Parameters	Banana Stem Char	Banana Peel Char
Moisture (%)	7.6	6.8
Ash (%)	10.023	9.780
Bulk density (g/cm ³)	1.34	0.85
pH	6.9	6.5

The Removal of Methylene Blue Solution by using of Banana Stem and Peel Char Samples Effects of concentration on the adsorption of methylene blue using banana stem and peel char samples

The results of the effect of concentration on the adsorption of methylene blue onto banana stem and peel char are shown in Table 2 and Figures 2.a and 2.b. Generally, it was also found that the adsorption of methylene blue on banana stem and peel char decreased with the initial concentration of methylene blue increased. It was able to adsorb an initial concentration of 10 ppm

to 40 ppm solution of methylene blue. It can be seen that the adsorption of methylene blue onto banana peel char is higher than banana stem char.

Table 2. Effect of Concentration on the Removal of Methylene Blue using Banana Stem and Peel Char Samples

Initial Concentration (ppm)	Percent Removal (%)	
	Stem	Peel
10	87.70	88.46
20	73.90	79.75
30	70.40	75.82
40	68.80	70.58

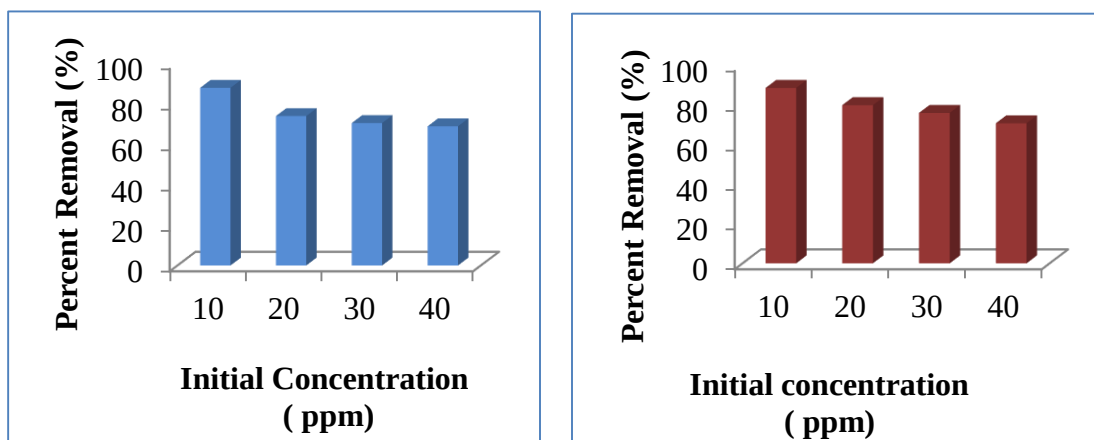


Figure 2. The removal of methylene blue using (a) banana stem char and (b) banana peel char samples as a function of various initial concentration

Effect of contact time on adsorption of methylene blue using banana stem and peel char samples

The equilibrium time required for the adsorption of methylene blue (initial concentration 10 ppm) on banana stem and peel char samples with 2.5 g of the adsorbent at different time intervals were studied. The resultant data are shown in Table 3 and Figures 3.a and 3.b. The rate of adsorption is higher in the beginning due to large available surface area of the adsorbent. After the capacity of the adsorbent gets exhausted, i.e., at equilibrium, the rate of uptake is controlled by the rate at which the adsorbance is transported from the exterior to the interior sites of the adsorbent particles. The extent of adsorption increases with time and attained equilibrium for all the adsorbent at 60 minutes.

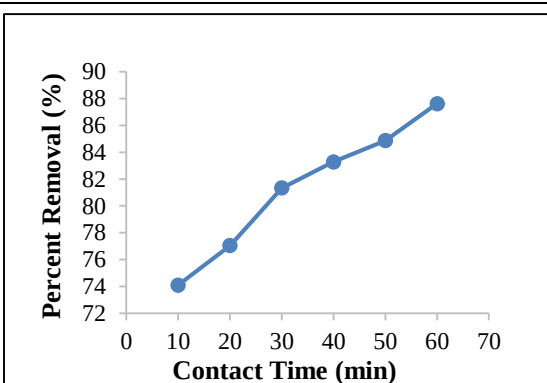
Effect of adsorbent dosage on adsorption of methylene blue using banana stem and peel char samples

The adsorption of methylene blue was investigated by taking 10 ppm dye concentration, at pH 7, 60 minutes contact time, temperature of 25 °C, stirring and different adsorbent concentrations. As in Figure 4, it can be clearly seen that with increasing adsorbent dosage,

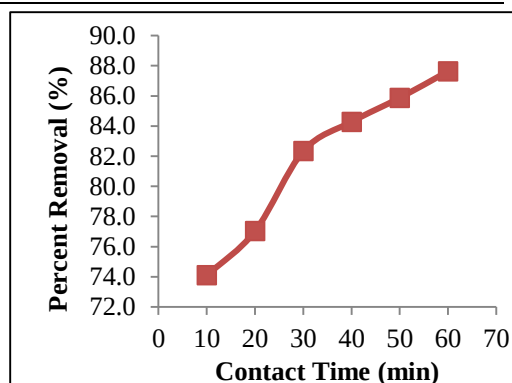
removal dye percentage also increased. This is due to the increased surface area and availability of adsorption. The resultant values are shown in Table 4 and Figures 4.a and 4.b.

Table 3 Effect of Contact Time on the Removal of Methylene Blue using Banana Stem and Peel Char Samples

Contact Time (min)	Percent Removal (%)	
	Stem	Peel
10	74.10	73.51
20	77.04	78.37
30	81.34	82.97
40	83.28	84.69
50	84.87	85.41
60	87.63	88.46



(a) Banana stem char



(b) Banana peel char

Figure 3 The removal of methylene blue using (a) banana stem char and (b) banana peel char samples at different contact time

SEM analysis of before and after methylene blue sorbed on banana stem and peel char samples

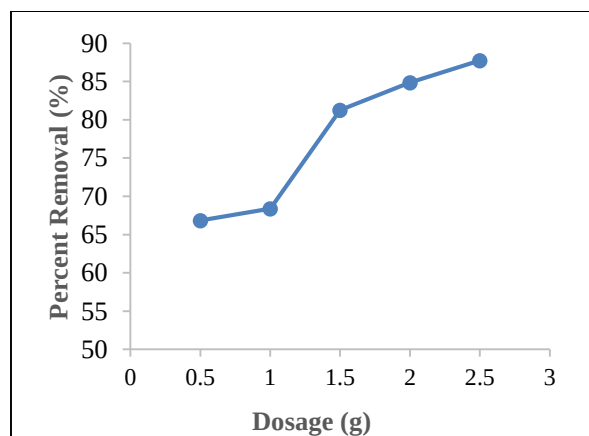
Figures 5.a and 5.b present the SEM micrographs of before and after sorbed methylene blue on banana stem char and Figures 6.a and 6.b show the SEM micrographs of before and after sorbed methylene blue on banana peel char.

Sorption Isotherms

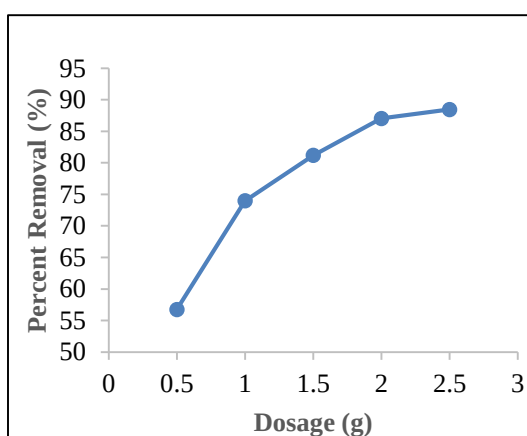
Table 5 represents the adsorption data of methylene blue using banana stem char for Langmuir and Freundlich Isotherms. Figures 7 and 8 show the Langmuir and Freundlich isotherms for adsorption of methylene blue solution by banana stem char sample.

Table 4. Effect of Adsorbent Dosage on the Removal of Methylene Blue using Banana Stem and Peel Char Samples

Dosage (g)	Percent Removal (%)	
	Stem	Peel
0.5	66.83	56.74
1.0	68.39	73.97
1.5	81.25	81.18
2.0	84.85	87.02
2.5	87.74	88.46

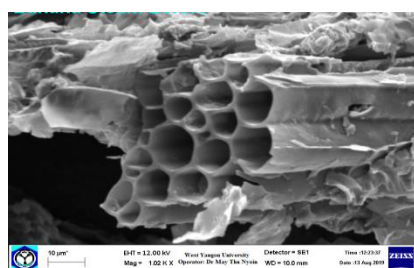


(a) Banana stem char

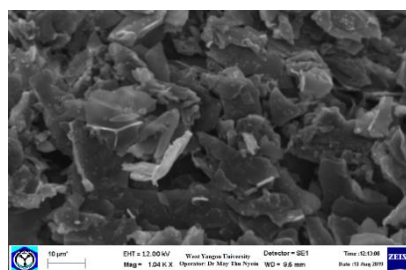


(b) Banana peel char

Figure 4. The removal of methylene blue using (a) banana stem char and (b) banana peel char samples at different dosage of adsorbent



(a)



(b)

Figure 5. SEM micrographs of (a) before and (b) after sorbed methylene blue on banana stem char

Table 6 represents the adsorption data of methylene blue by banana peel char for Langmuir and Freundlich Isotherms. Figures 9 and 10 show the Langmuir and Freundlich isotherms for adsorption of methylene blue solution by banana peel char sample. The calculated results of Langmuir and Freundlich isotherms constants are presented in Table 7. From Langmuir isotherm studies, the removal capacity of banana stem char was 0.5621 mg g^{-1} and banana peel char was 5.9991 mg g^{-1} for methylene blue adsorptions. From Freundlich isotherm studies, the adsorption

capacity of banana stem char was 0.2420 mg g⁻¹ and banana peel char was 0.3252 mg g⁻¹ for methylene blue adsorption.

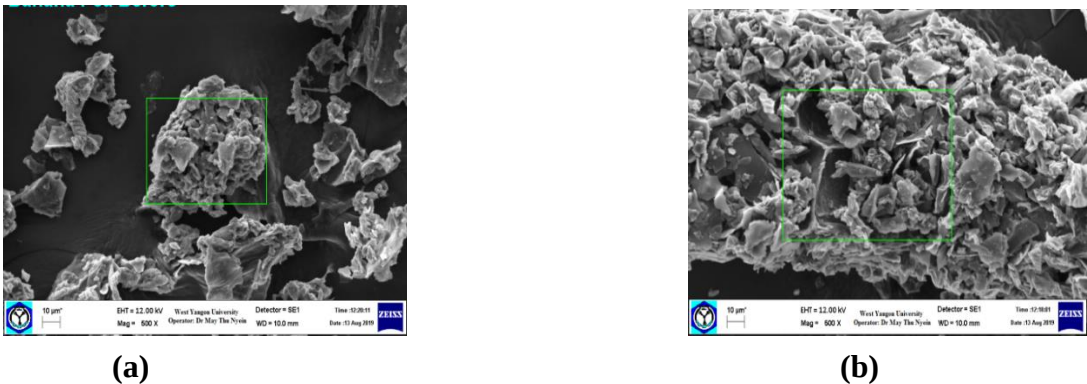


Figure 6. SEM micrographs of (a) before and (b) after sorbed methylene blue on banana peel char

Table 5 Adsorption of Methylene Blue Using Banana Stem Char for Langmuir and Freundlich Isotherms

Dosage	C ₀	C _e	x	x/m	m/x	1/C _e	Log C _e	Log x/m
(g/100 mL)	(mgL ⁻¹)	(mg L ⁻¹)	(mg L ⁻¹)	(mg g ⁻¹)	(g mg ⁻¹)	(mg ⁻¹ L)		
0.5	1.387	0.600	0.787	0.157	6.30	1.65	-0.221	-0.803
1.0	1.387	0.361	1.026	0.102	9.75	2.80	-0.442	-0.988
1.5	1.387	0.261	1.126	0.075	13.33	3.85	-0.583	-1.124
2.0	1.387	0.180	1.207	0.060	16.58	5.72	-0.744	-1.219
2.5	1.387	0.160	1.227	0.049	20.40	6.20	-0.795	-1.309

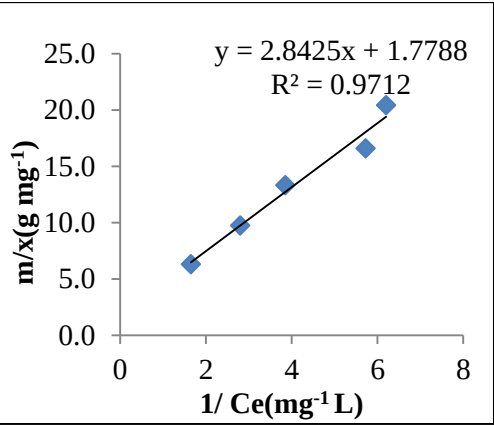


Figure 7. Langmuir isotherm: sorption of methylene blue on banana stem char

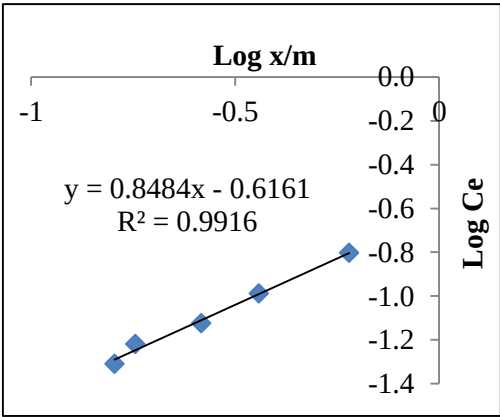


Figure 8. Freundlich isotherm: sorption of methylene blue on banana stem char

Table 6. Adsorption of Methylene Blue using Banana Peel Char for Langmuir and Freundlich Isotherms

Dosage	C ₀	C _e	x	x/m	m/x	1/C _e	Log C _e	Log x/m
(g/100 mL)	(mg L ⁻¹)	(mg L ⁻¹)	(mg L ⁻¹)	(mg g ⁻¹)	(g mg ⁻¹)	(mg ⁻¹ L)		
0.5	1.387	0.42	0.927	0.185	5.390	2.15	-0.376	-0.813
1.0	1.387	0.48	0.907	0.090	11.02	2.29	-0.397	-1.005
1.5	1.387	0.26	1.127	0.075	13.31	3.85	-0.585	-1.124
2.0	1.387	0.21	1.177	0.058	17.00	4.76	-0.677	-1.230
2.5	1.387	0.17	1.217	0.048	20.80	5.80	-0.769	-1.313

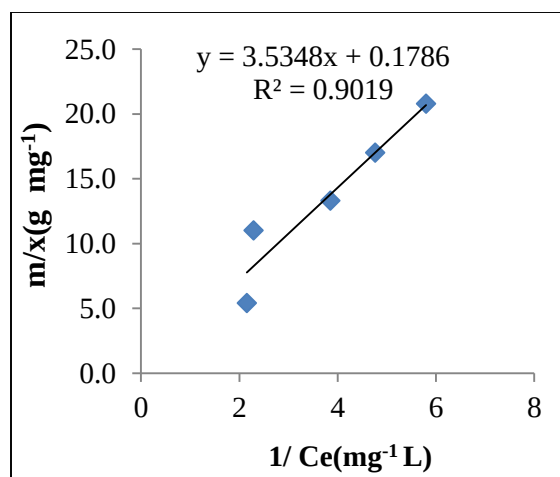


Figure 9. Langmuir isotherm: sorption of methylene blue on banana peel char

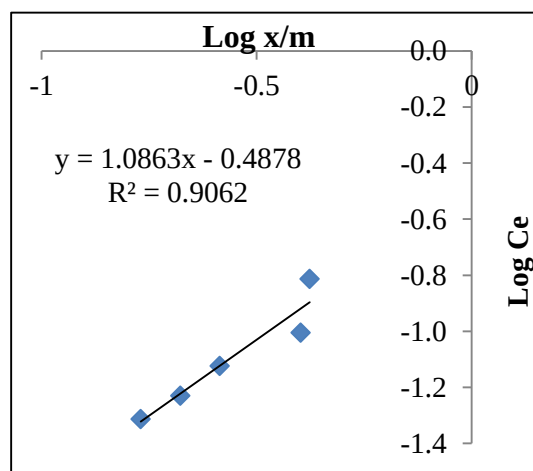


Figure 10. Freundlich isotherm: sorption of methylene blue on banana peel char

Table 7. Values of Langmuir and Freundlich Isotherms Constant for Removal of Methylene Blue using Banana Stem and Peel Char Samples

Sorbents	Langmuir constants			Freundlich constants		
	X _m (mg g ⁻¹)	b (L mg ⁻¹)	R ²	K (mg g ⁻¹)	n	R ²
Banana stem char sample	0.5621	0.6258	0.9712	0.2420	1.1786	0.9916
Banana peel char sample	5.5991	0.0505	0.9019	0.3252	0.9205	0.9062

Conclusion

This study revealed that the evaluation of banana stem and peel char samples with regards to decolourization nature of methylene blue in aqueous solution. Banana stem and peel were

collected from Nyaung Ni Village, Thongwa Township, Yangon Region. The purified banana stem and peel were thermally treated at optimum temperature of 600 °C for 1 to 2 hrs. The SEM micrographs of banana stem and peel char were found that there were many uniforms flacked like nature. The adsorption parameters such as the effect of initial concentration, contact time and dosage were also investigated for the removal of dye (methylene blue) on banana stem and peel char samples. It was deduced that the percent removal of dye increases with increasing in contact time. The removal percent of methylene blue using banana stem char was found to be 87.70 % and banana peel char was found to be 88.46 % respectively. From Langmuir isotherm studies, the amount of monolayer coverage is confirmed the removal efficiencies of methylene blue using banana stem char was 0.5621 mg g⁻¹ and banana peel char was 5.5991 mg g⁻¹. Freundlich isotherm studies, the adsorption capacity of banana stem char was 0.2420 mg g⁻¹ and banana peel char were 0.3252 mg g⁻¹ for methylene blue. In contract, from the whole research, banana peel char is more effective sorption than that of banana stem char for the removal of methylene blue dye.

Acknowledgements

First of all, We wish to express our deepest appreciation and special thanks to Dr. Nay Win Oo (Rector), Dr Aye Aye Ko (Pro- Rector), Dr Wah Wah Lwin (Pro-Rector) and Dr Thidar Aung (Pro-Rector), of East Yangon University for their kind permission to submit this paper. We would like to express our sincerest thanks to Dr Myo Myo Myat, Professor and Head, Dr Than Than Oo (Professor), and Dr Myint Myint May (Professor), Department of Chemistry, East Yangon University for the encouragement and advice. Our special thanks also are going to Dr Win Pa Pa, Professor and Head of Department Chemistry, Nationalities Youth Resource Development Degree College (Yangon) for giving us wisdom and patience to complete this paper.

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ISOLATION AND CHARACTERIZATION OF PAPAIN FROM LATEX OF PAPAYA (*CARICA PAPAYA* L.)

Khin Yadanar Ko Ko¹, Yin Min²

Abstract

Papain (EC 3.4.22.2) is proteolytic enzyme which is extracted from papaya latex (*Carica papaya* L.). The collection of fresh papaya latex was taken from locally grown papaya tree from Nyaung Pinn Kwin Village, Khayan Township, Yangon Division. Papain breaks down proteins and tyrosine are produced as the major product. Therefore, proteolytic activity of papain was determined by the concentration of tyrosine liberated from substrate casein. The wavelength of maximum absorption of tyrosine was found to be 274 nm. In the standard calibration curve for tyrosine determination, the curve is linear and passed through the origin so Beer's law was obeyed. The protein content in papain enzyme was determined by modified Biuret method. The wavelength of maximum absorption of copper protein complex in Biuret method was found to be 540 nm. In this assay, the maximum proteolytic activity was $0.0354 \pm 0.0032 \mu\text{mol min}^{-1} \text{mL}^{-1}$. The optimum pH of papain was 7.4 and optimum temperature was 67 °C. The enzyme unit EU of papain was found to be 0.6307 EU per gram of papaya latex. The K_m and $V_{\max}$ value of enzyme was found to be $0.195 \times 10^{-2} \text{ g mL}^{-1}$ and $2.538 \times 10^{-5} \text{ M min}^{-1}$, respectively. The reaction order (n) of papain-catalyzed reaction was found to be 0.99 indicating the first order reaction. In this research, prepared papain was used as protein clotting material in milk coagulation process for the production of cheese.

Keywords: Papaya latex, papain, tyrosine, casein, proteolytic enzymes, Biuret method

Introduction

Papaya is called “Thim-baw” in Myanmar. The botanical name of papaya tree is *Carica papaya* L. (Akah *et al.*, 1997.). *Carica papaya* L., sometimes known as paw paw. The *Carica papaya* L. belongs to family Caricaceae commonly known as papaya in English. *Carica papaya* L. contain some biologically active compound such as papain and chymopapain. Papaya is a power house of nutrients. It is a rich source of three powerful antioxidants vitamin C, vitamin A, and vitamin E (Aravind *et al.*, 2013). Papain enzyme presents in the leaves, latex, roots and fruit of the papaya plant (*Carica papaya* L.). The papain (EC 3.4.22.2) is hydrolyzing casein and giving the product of tyrosine. Therefore, the enzyme activity was followed by determining the tyrosine product. Tyrosine determination was done by measuring UV-visible spectrophotometric method. The successive purifications of the enzyme from papaya latex were prepared by precipitation of solid ammonium sulphate using pH (7.4) phosphate buffer. The proteolytic activity of papain enzyme was studied on hydrolysis of casein and enzyme kinetic parameters (K_m , $V_{\max}$ and reaction order) were comparatively determined. Papain enzyme can also be used as a protein clotting material in milk coagulation for the production of cheese.

Materials and Methods

Determination of Wavelength of Maximum Absorption of Tyrosine

Tyrosine (0.01 g) was dissolved in 5 % trichloroacetic acid solution and the volume was made up to 50 mL in a volumetric flask (Boyd and Marr, 1980). 5 % trichloroacetic acid solution, used as reagent blank was placed in the reference cell whereas standard tyrosine solutions were

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placed in the sample cell of a UV-visible spectrophotometer and the spectra scanned between 250 and 300 nm. The wavelength of maximum absorption was found at 274 nm.

Construction of Calibration Curve for Standard Tyrosine Solutions

The procedure was the same as that described above. Half dilutions of above solution were successively made in the same manner as above to obtain 0.550, 0.275, 0.138, 0.069, 0.034 and 0.017 mM solution respectively. The absorbance of six different concentrations of standard tyrosine solutions were measured at 274 nm against the blank solution with a UV-visible spectrophotometer.

Latex Extraction and Collection

Unripe matured papaya fruit was tapped early morning and finished by mid-late morning. Vertical cut of 1-2 mm deep was made using a stainless steel knife. A plastic dish was used to collect the latex. The latex was then scraped into a plastic box with a close fitting lid. Latex adhering to the fruit was carefully scraped off and transferred to the collecting box using plastic spoon.

Extraction of Papain from Papaya Latex

Papaya latex (10.0 g) were mixed with 100 mL of 0.2 M phosphate buffer (pH 7.4) and stirred for 2 hours at room temperature. And then solid ammonium sulphate (45.0 g) was added to this extract to obtain 50 % saturation and stirred for 2 hours. After standing overnight, the precipitated protein containing papain enzyme was collected by centrifugation for 30 min at 5000 rpm and dissolved in 10 mL of 0.2 M phosphate buffer (pH 7.4) to obtain crude enzyme as opaque solution. Total volume of final enzyme solution was 89 mL.

Characterization of Papain from Latex of Papaya (*Carica papaya* L.)

For enzyme assay the activity of papain was determined by UV-visible spectrophotometric method at 274 nm using casein as a substrate. EU was calculated from papain enzyme activity. Protein content was determined by Biuret method using Bovine Serum Albumin (BSA) as standard at 540 nm. Specific activity was calculated by using enzyme activity and protein content. Effect of pH, temperature, reaction time, substrate concentrations were determined by spectrophotometric method. And also, the kinetic parameters such as K_m and V_{max} and reaction order of papain-catalyzed reaction were determined. The papain enzyme was also used as a milk protein clotting material.

Results and Discussion

Wavelength of Maximum Absorption of Tyrosine Solution

In this study, proteolytic enzyme presents in latex of papaya that breaks down protein (casein), tyrosine is produced. Therefore, the maximum wavelength of tyrosine was determined in the wavelength range of 250 - 300 nm (Aitken and Learnmonth, 2009). The wavelength of maximum absorption was found to be 274 nm as shown in Table 1 and Figure 1. Therefore, other enzyme parameters were measured at this wavelength.

Calibration Curve for Standard Tyrosine Solution using Ultraviolet Spectroscopy

In this study, the absorbance of the six different concentrations of standard tyrosine (0.550, 0.275, 0.138, 0.069 and 0.034 and 0.017 mM) were measured at 274 nm. The nature of the plot of absorbance vs. concentration of tyrosine gives a straight line passing through the origin showing the Beer's Law was obeyed as shown in Table 2 and Figure 2. The standard comparison method was used for determination of results.

Activity of Papain from Papaya Latex

The activity of isolated papain was found to be $0.0354 \pm 0.0032 \mu\text{mol min}^{-1} \text{mL}^{-1}$. The enzyme unit EU of papain was found to be 0.6307 EU per gram of papaya latex.

Construction of Standard Calibration Curve for Protein using Visible Spectroscopy (Modified Biuret Test)

In this work, bovine serum albumin (BSA) was used as standard and the protein concentration was determined by using biuret test. The different absorbance values were obtained for various standard protein solutions by using a UV-visible spectrophotometer. It was found that the nature of the plot of absorbance at 540 nm vs. standard protein concentration (mg mL^{-1}), was a straight line passing through the origin showing that Beer's Law was obeyed. As a result, the solution was found purple color indicate that the presence of protein molecules. Protein content from latex extract was $0.0188 \text{ mg protein mL}^{-1}$.

Table 1. Relationship between Absorbance and Wavelength of Tyrosine Solution

Wavelength(nm)	Absorbance
250	0.333
255	0.416
260	0.655
265	0.984
270	1.311
274	1.496
275	1.486
280	1.274
285	0.664
290	0.137
295	0.048
300	0.036

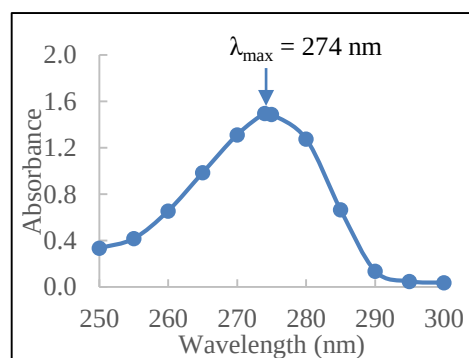


Figure 1. UV spectrum of tyrosine solution

Table 2. Relationship between Absorbance and Standard Tyrosine Concentration

No.	Concentration (mM)	Absorbance at 274 nm
1.	0.000	0.000
2.	0.017	0.024
3.	0.034	0.047
4.	0.069	0.092
5.	0.138	0.182
6.	0.275	0.364
7.	0.550	0.717

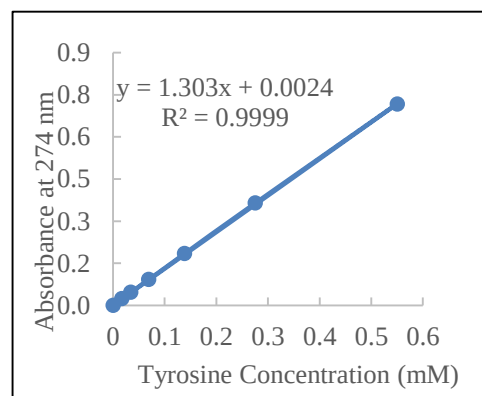
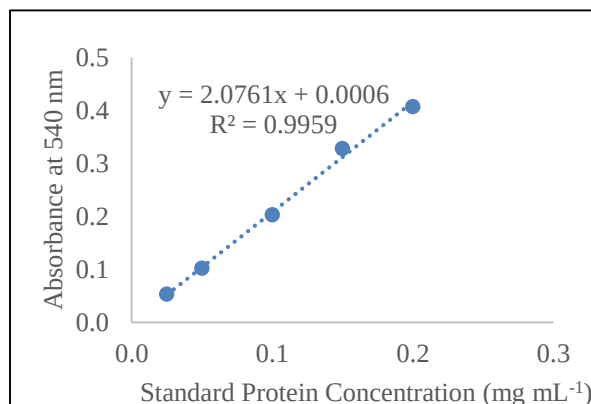


Figure 2. Calibration curve for standard tyrosine solutions

Table 3. Relationship between Absorbance and Standard Protein Concentration using Modified Biuret Test

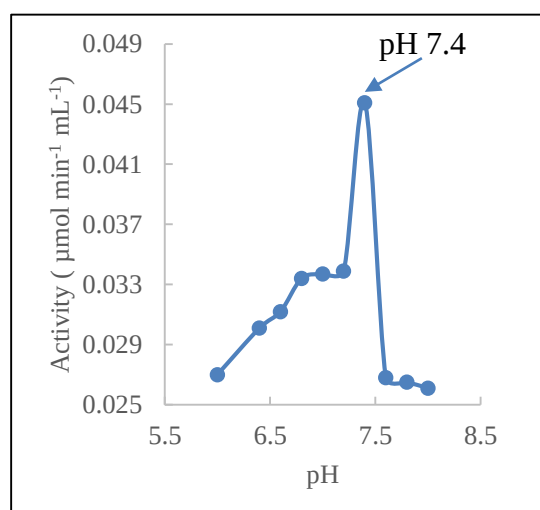
No.	Standard Protein Concentration (mg mL ⁻¹)	Absorbance at 540 nm
1.	0.025	0.053
2.	0.050	0.102
3.	0.100	0.203
4.	0.150	0.328
5.	0.200	0.400

**Figure 3. Plot of absorbance as a function of concentration of standard protein solution****Optimum pH for Papain-Catalyzed Reaction**

Enzymes are affected by changes in pH. Changing the pH outside of this range will slow the enzyme activity. Extremely pH value can cause enzymes to denature. At optimum pH the enzyme activity is maximum and above and below this pH, the activity is low (Lehninger, 1975). In this study, the effect of pH on enzyme activity was determined by using phosphate buffer solution ranging from pH 6.0 to 8.0. The nature of the enzyme activity vs. pH value of the enzyme was shown in Table 4 and Figure 4. The optimum pH was obtained at pH 7.4 and papain activity was 0.0451 $\mu\text{mol min}^{-1} \text{mL}^{-1}$.

Table 4. Relationship between Proteolytic Activity and pH of the Solution

pH	Absorbance at 274 nm	Activity ($\mu\text{mol min}^{-1} \text{mL}^{-1}$)	Velocity (mM min^{-1})
6.0	0.547	0.0279	0.0139
6.4	0.588	0.0301	0.0150
6.6	0.609	0.0312	0.0155
6.8	0.654	0.0334	0.0167
7.0	0.660	0.0337	0.0169
7.2	0.694	0.0339	0.0177
7.4	0.882	0.0451	0.0223
7.6	0.525	0.0268	0.0134
7.8	0.518	0.0265	0.0132
8.0	0.510	0.0261	0.0130

**Figure 4. Plot of proteolytic activity as a function of pH of solution**

Optimum Temperature for Papain-Catalyzed Reaction

In the determination of optimum temperature, the temperature was increased from 27 °C to 87 °C while the preparation of 1 % casein substrate medium and the optimum pH (7.4) was fixed. The optimum temperature for the papain enzyme was found to be 67 °C and papain activity was obtained at $0.033 \mu\text{mol min}^{-1} \text{mL}^{-1}$. It was found that the activity of papain was increased from 27 °C to 67 °C and then decreased from 67 °C to 87 °C due to denature of enzyme as shown in Table 5 and Figure 5.

Table 5. Relationship between Proteolytic Activity and Temperature of the Solution

Temperature (°C)	Absorbance at 274 nm	Activity ($\mu\text{mol min}^{-1} \text{mL}^{-1}$)	Velocity (mM min^{-1})
27	0.487	0.025	0.012
37	0.512	0.026	0.013
47	0.553	0.028	0.014
57	0.579	0.029	0.015
67	0.639	0.033	0.016
77	0.589	0.030	0.015
87	0.567	0.029	0.014

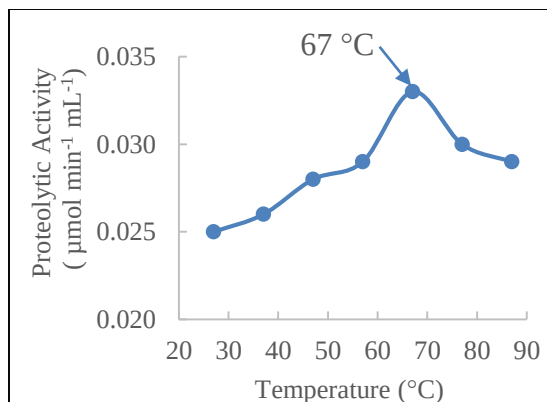


Figure 5. Plot of proteolytic activity as a function of temperature of the solution

Effect of Reaction Time on Proteolytic Activity of Papain Catalyzed Reaction

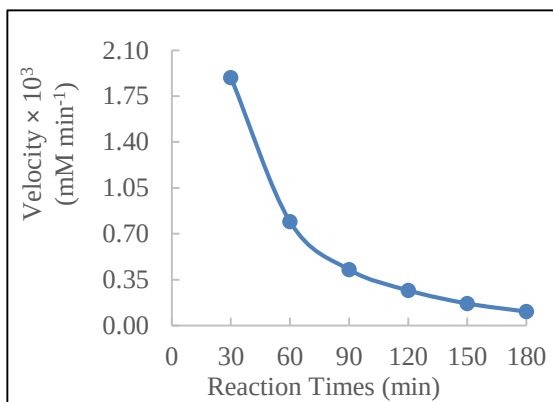
The activity of the papain on casein was studied in phosphate buffer of pH (7.4). The amount of tyrosine liberated during the various reaction times of 30, 60, 90, 120, 150 and 180 min were determined by UV-visible spectroscopic method. The plot of velocity vs. reaction time for papain revealed that the velocity decreased linearly with time up to 90 min so that the reaction time of 30 min was chosen for the enzyme kinetic experiment as shown in Table 6 and Figure 6.

Effect of Substrate Concentration on Papain Catalyzed Reaction

In the present work, the velocities of enzyme reaction measured at different levels of substrate concentration and their reciprocal values are shown in Table 7. The Michaelis-Menten plot of V vs. $[S]$ is shown in Figure 7. The optimum substrate concentration was found to be 1.8 %. At this concentration enzyme retained saturated with substrate for 30 min and rate of reaction was maximum at this concentration. In this work, statistical methods (linear regression) were used for obtaining V_{max} and K_m from experimental results. These values are shown in Table 8 in comparison with V_{max} and K_m values obtained by Lineweaver-Burk (Figure 8), Eadie-Hofstee (Figure 9), Hanes-Wilkinson plots (Figure 10). These values were not much different from each other. However, the K_m and V_{max} values of Michaelis-Menten plot are totally different from other techniques. Michaelis-Menten plot gives only apparent K_m and V_{max} values.

Table 6. Relationship between Reaction Time and Velocity of Papain Enzyme Catalyzed Reaction

Reaction time (min)	Absorbance at 274 nm	Velocity $\times 10^3$ (mM min ⁻¹)
30	0.074	1.900
60	0.062	0.792
90	0.050	0.426
120	0.042	0.268
150	0.033	0.168
180	0.025	0.106

**Figure 6. Plot of velocity as a function of reaction time for proteolytic activity of papain enzyme-catalyzed reaction****Table 7 Relationship between Casein Concentration and Velocity of Papain Catalyzed Reaction**

No.	[S] $\times 10^2$ (g mL ⁻¹)	- [S] $\times 10^2$ (g mL ⁻¹)	1/[S] $\times 10^{-2}$ (g ⁻¹ mL)	V $\times 10^5$ (M min ⁻¹)	1/V $\times 10^{-5}$ (M ⁻¹ min)	V/[S] $\times 10^{-3}$ (M min ⁻¹ g ⁻¹ mL)	[S]/V $\times 10^{-3}$ (g mL ⁻¹ M ⁻¹ min)
1.	0.13	- 0.13	7.692	1.012	0.988	7.785	0.128
2.	0.40	- 0.40	2.500	1.714	0.583	4.285	0.233
3.	0.67	- 0.67	1.493	1.986	0.504	2.964	0.337
4.	0.93	- 0.93	1.075	2.092	0.478	2.249	0.445
5.	1.20	- 1.20	0.833	2.163	0.462	1.803	0.555

Reaction Order (n) for Papain-Catalyzed Reaction

The order of a chemical reaction can be defined as the power dependence of the rate on the concentration for all reactants. K_m and n values were determined from the plot of $\log \frac{V}{V_{\max} - V}$ vs.

$\log [S]$ for papain using the linear regression method as shown in Table (9) and Figure (11). The reaction order (n) for papain was calculated to be 0.99 proving that the reaction order is first order.

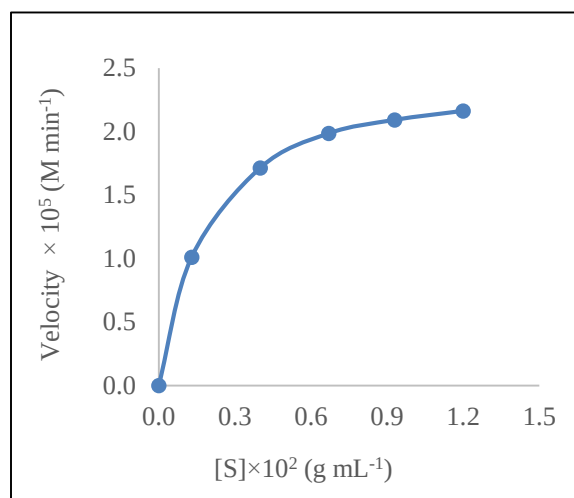


Figure 7. Michaelis-Menten plot of V vs. [S] used for graphic evaluation of $V_{\max}$ and K_m for papain

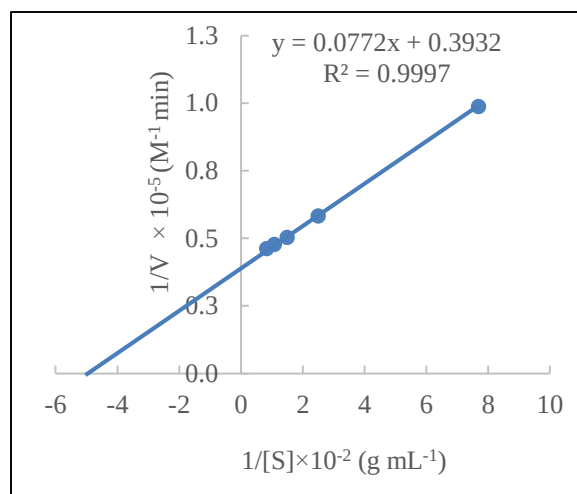


Figure 8. Lineweaver-Burk plot of $1/V$ vs. $1/[S]$ used for graphic evaluation of $V_{\max}$ and K_m for papain

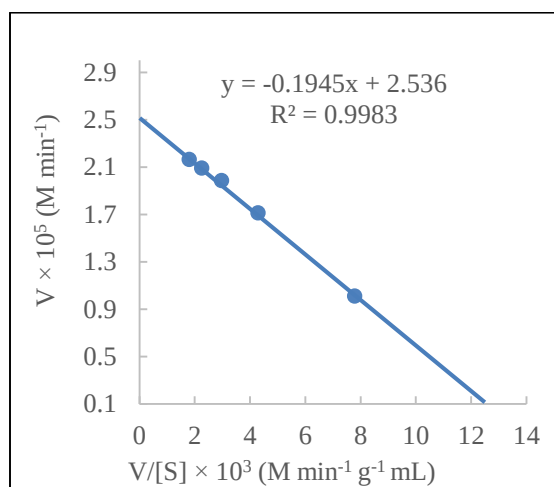


Figure 9. Eadie-Hofstee plot of velocity vs. $V/[S]$ used for graphic evaluation of $V_{\max}$ and K_m for papain

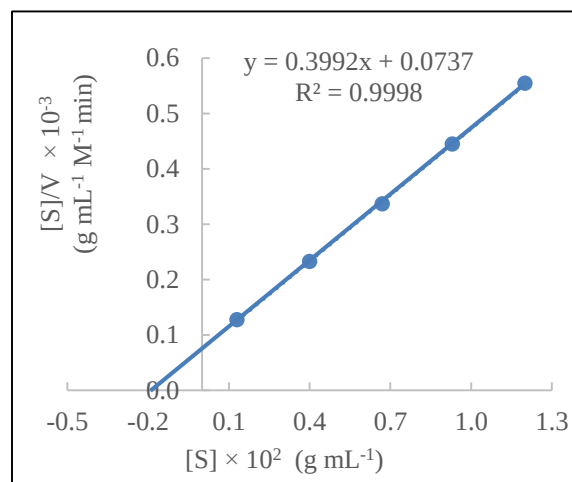


Figure 10. Hanes-Wilkinson plot of $[S]/V$ vs. $[S]$ used for graphic evaluation of $V_{\max}$ and K_m for papain

Coagulation of Milk

The papain enzyme can also be used as a milk protein clotting material in the process of making cheese. Coagulation milk, papain digests the precipitate caseins (Ilany and Netzer, 1967). Milk coagulation is the main step for producing cheese. The action of papain on milk solution was studied at room temperature. The clotting of milk solution was formed after 30 min as shown in

Figure 12. This may be precipitation of caseins when papain digested the protein in milk. This experiment is partially applied in the main step for producing cheese.

Table 8. Comparison of K_m and V_{max} Values of Papain Calculated from Different Methods

No.	Method	Statistical		Graphical	
		$K_m \times 10^2$ (g mL ⁻¹)	$V_{max} \times 10^5$ (M min ⁻¹)	$K_m \times 10^2$ (g mL ⁻¹)	$V_{max} \times 10^5$ (M min ⁻¹)
1.	Linearweaver-Burk	0.195	2.538	0.220	2.635
2.	Eadie-Hofstee	0.195	2.538	0.193	2.554
3.	Hanes-Wilkison	0.185	2.504	0.211	2.581
4.	Michaelis-Menten	-	-	0.173	2.192

Table 9 Reaction Order (n) and K_m Value for Papain Enzyme-Catalyzed Reaction By Hill equation

[S] $\times 10^2$ (g mL ⁻¹)	Log[S]	$V \times 10^5$ (M min ⁻¹)	$\log \frac{V}{V_{max} - V}$
0.13	-2.8861	1.012	-0.178
0.40	-2.3979	1.714	0.318
0.67	-2.1739	1.986	0.556
0.93	-2.0315	2.092	0.671
1.20	-1.9208	2.163	0.761

n = 0.99

n = (first order)

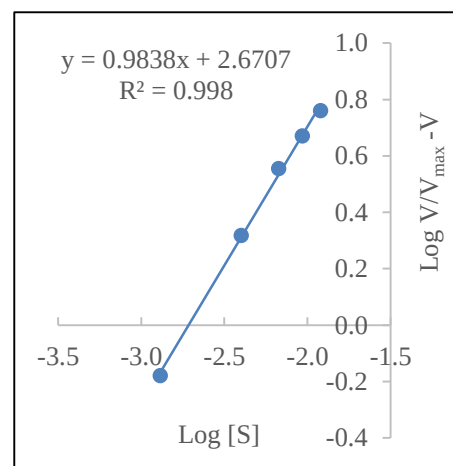


Figure 11 Plot of $\log V/V_{max} - V$ as a function of $\log [S]$ for proteolytic activity of papain-catalyzed reaction

Conclusion

In this research, papain EC (3.4.22.2) was isolated from papaya latex by ammonium sulphate precipitation method. The papain enzyme has the proteolytic activity and therefore, it hydrolyzed casein into amino acid, the tyrosine was produced as products. The protein content of enzyme solution was determined by modified Biuret method. Protein content from latex extract was 0.0188 mg protein mL⁻¹. The activity of papain enzyme was $0.0354 \pm 0.0032 \mu\text{mol min}^{-1} \text{mL}^{-1}$. The optimum pH and optimum temperature of papain enzyme was found to be 7.4 and 67°C,

respectively. Enzyme kinetic parameter such as maximum velocity ($V_{\max}$), Michaelis-Menten constant (K_m) and reaction order (n) were determined by using linear regression and various graphical method. The $V_{\max}$ and K_m were determined to be $2.538 \times 10^{-5} \text{ M min}^{-1}$ and $0.195 \times 10^{-2} \text{ g mL}^{-1}$, respectively. The reaction order (n) of protease-catalyzed reaction was calculated by using linear regression method and it was found to be 0.99 indicating the first order reaction. The papain enzyme was applied to the milk coagulation process, initiating for production of cheese.

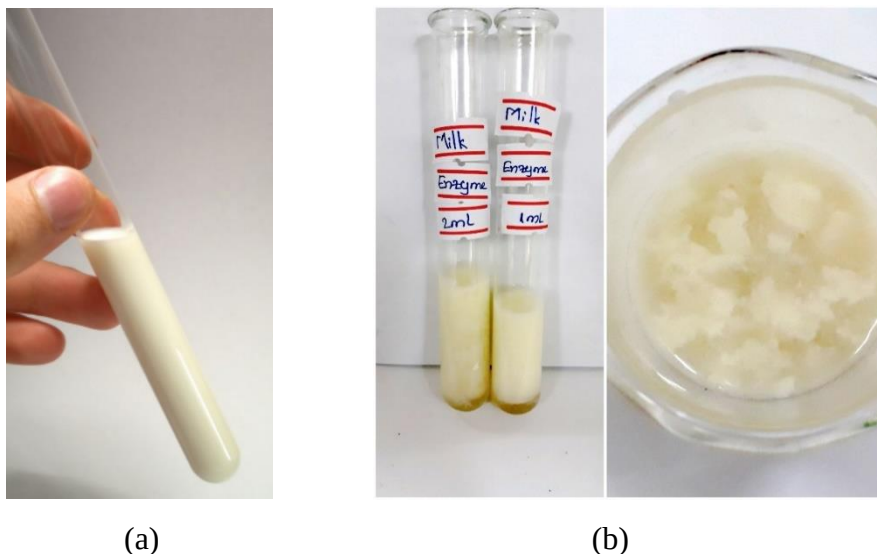


**Figure 12. (a) Milk solution before treatment with papain
(b) Coagulation of milk after treatment with papain**

Acknowledgements

The authors would like to thank to the Department of Higher Education, Ministry of Education, Myanmar. We also would like to express our sincere thanks to Rector Dr Nay Win Oo, Pro-Rectors Dr Aye Aye Ko, Dr Wah Wah Lwin and Dr Thida Aung, East Yangon University. Our warmest thanks are also extended to Dr Myo Myo Myat (Professor and Head), Dr Than Than Oo and Dr Myint Myint May (Professors), Department of Chemistry, East Yangon University, for their kind encouragement, permission to submit this paper and gave many helpful suggestions.

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SCREENING OF PHYTOCHEMICALS AND SOME BIOACTIVITIES OF *KIGELIA AFRICANA* (LAM.) BENTH. FRUITS (SAUSAGE TREE)

Pan Ei San*

Abstract

Kigelia africana (Lam.) Benth., (Family- Bignoniaceae) is commonly known as sausage tree due to the shape of its fruit. The fruits are the most popularly used part in traditional medicine. In this study, the fruits of *Kigelia africana* was chosen to be studied. The phytochemical constituents, nutritional values, elemental analysis and some bioactivities such as antioxidant activity and cytotoxicity of *Kigelia africana* fruits were investigated. The preliminary phytochemical tests showed the presence of alkaloids, α -amino acids, carbohydrates, saponins, phenolic compounds, reducing sugars, flavonoids, steroids, terpenoids and glycosides while starch was not found in *Kigelia africana* fruits. Nutritional values such as moisture, ash, protein, fat, fiber, carbohydrates and energy values of *Kigelia africana* fruits were determined by AOAC methods. The elemental analysis of the fruit sample was studied by EDXRF spectrometry, resulting the content of K, P, Ca, S, Fe, Cu and Zn. The extractable matter contents of the fruit sample (% w/w) obtained by extraction with different solvents such as H₂O, EtOH, EtOAc, and PE were in order of 22.67 % > 18.30 % > 8.32 % > 0.47 % respectively. The antioxidant activity of EtOH, H₂O and EtOAc extracts were determined by DPPH free radical scavenging assay. IC₅₀ values of EtOH extract (6.23 μ g/mL) was found to possess the highest antioxidant activity compared to the other extracts. The cytotoxicity of EtOH and H₂O extracts on brine shrimp were nearly equal with IC₅₀ values of 243.71 μ g/mL and 237.27 μ g/mL respectively. Standard caffeine did not show cytotoxicity effect until 1000 μ g/mL concentration whereas IC₅₀ value of cytotoxic standard K₂Cr₂O₇ was 55.01 μ g/mL. So, both extract samples have no cytotoxic effect compared with standard K₂Cr₂O₇. The research indicated that *Kigelia africana* fruits have a good source of many constituents with different pharmacological activities and can be used as a source of alternative medicine.

Keywords: *Kigelia africana* (Lam.) Benth., phytochemical constituents, nutritional values, elemental analysis, antioxidant activity, cytotoxicity

Introduction

Kigelia africana belongs to the family Bignoniaceae, is native from Africa. It is widely distributed in the South, Central, and West Africa. *Kigelia africana* is commonly referred to sausage or cucumber tree. Tree of *Kigelia africana* is approximately 20 m long, either evergreen or deciduous depending on the rainfall condition in different parts of the world. *Kigelia africana* is characterized by its huge fruits which can weigh between 5 to 10 kg. The fruit is a woody berry from 30-100 cm long and up to 18 cm broad, hanging down on rope-like peduncles. The fruit is indehiscent with woody wall and heavily marked with lenticels at the surface. The fruit pulp is fibrous and pulpy, and contains numerous seeds. It is eaten by several species of mammals, and the seeds are dispersed in their dung (Atawodi and Olowoniyi, 2015).

The *Kigelia* plant have a long history of use by rural communities, especially for its medicinal properties. These properties are found in all part of the tree, including fruit, bark, roots and leaves, which are used for medical purposes. The plant possesses medicinal and traditional uses like anticancer, antiulcer, anti-aging, antioxidant, and anti-malarial. It is also widely applied in the treatment of genital infections, gynecological disorders, renal ailments, fainting, epilepsy, rheumatism, sickle-cell anemia, psoriasis, eczema, central nervous system depression, respiratory

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ailments, skin complaint, body weakness, leprosy, worm infestation and tumors (Suman and Sharma, 2017).

Baked fruits are used to ferment beer and boiled ones yield a red dye. Unripe fruits are used in Central Africa as a dressing for wounds, haemorrhoids and rheumatism (Alfaki, 2015). Different parts of *Kigelia africana* have been used for various medicinal purposes in different parts of the world (Gabriel and Olubunmi, 2009).

Scientific Classification of *Kigelia africana* (Lam.) Benth. (Sausage Tree)

Family	: Bignoniaceae
Genus	: <i>Kigelia</i>
Species	: <i>africana</i>
Botanical Name	: <i>Kigelia africana</i> (Lam.) Benth.
English Name	: Sausage or Cucumber tree
Part Used	: Fruits

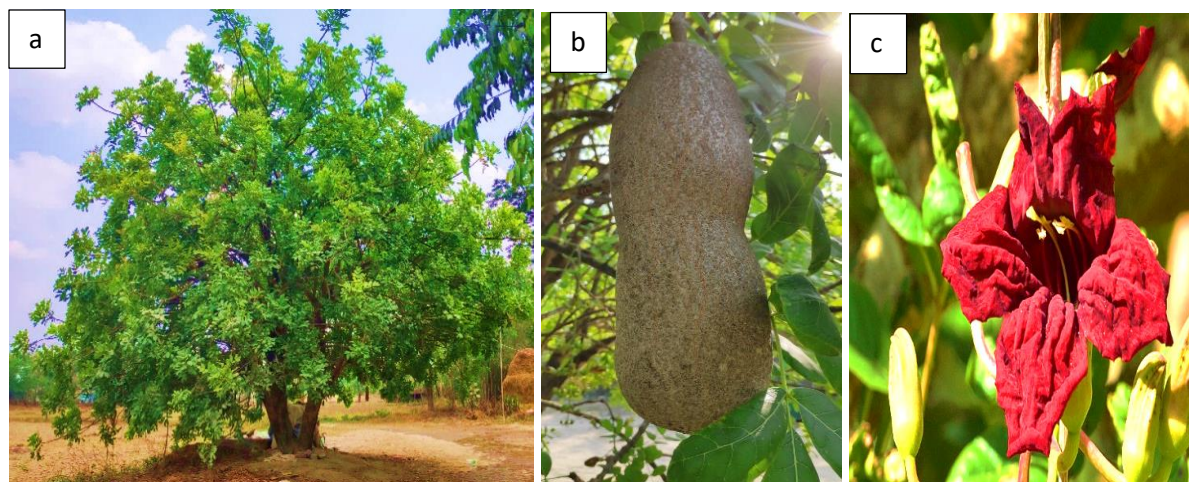


Figure 1. Photograph of *Kigelia africana* (Lam.) Benth. (a) Plant (b) Fruit (c) Flower

Materials and Methods

Collection and Preparation of Sample

The fruit of *Kigelia africana* (Lam.) Benth. (Sausage Tree) was collected from Ma Kyi Pouk Kan village at Thongwa Township, Yangon Region in December 2018. The selected sample was identified at the Department of Botany, East Yangon University. The collected sample was cleaned by washing thoroughly with water and then cut into small pieces and air-dried at room temperature. The dried sample was ground into powder by a blender. This dry powder sample was stored in air-tight containers to prevent moisture changes. The dried powder sample was used to investigate their chemical and biological activities.

Preliminary Phytochemical Investigation of *Kigelia africana* Fruits

Phytochemical tests for *Kigelia africana* fruits were carried out according to test tube methods to investigate the presence or absence of phytochemical constituents such as alkaloids, α -amino acids, carbohydrates, flavonoids, glycosides, phenolic compounds, reducing sugars, saponins, starch, steroids, tannins and terpenoids.

Determination of Nutritional Values of *Kigelia africana* Fruits

Determination of some nutritional values present in fruit sample such as moisture, ash, fiber, protein, fat and carbohydrate contents were carried out by the Association of Official Analytical Chemists (AOAC) method (AOAC, 2000). The moisture content of dried powder sample was determined by using the oven drying method. The ash content was determined by muffle furnace method. The protein content was determined by the micro kjeldahl method. The fat content was determined by the soxhlet extraction method. Fibre content was detected by acid-base treatment method. The total carbohydrate content of any food can be obtained as the difference between 100 and the sum of the percentages of moisture, protein, fat, ash and fibre.

Determination of Elemental Compositions of *Kigelia africana* Fruits by Energy Dispersive X-ray Fluorescence (EDXRF) Spectrometry

A dried powder sample (2.5 g) was fabricated into the pellet for EDXRF spectrometry. The samples were placed in the sample chamber of an EDX-7000 spectrometer that can measure the sixteen samples at a time. The chamber was pumped up to vacuum. The vacuum pressure was about 38 pa and the detector temperature is about -170 °C. Therefore, liquid nitrogen needs to be added at the time of analysis. Rhodium target was used in the EDX-7000 spectrometer. Each sample was run for a counting time of about 100 seconds and the spectrum obtained was stored and analyzed in PC based multi-channel analyzer using EDX-7000 software. The resulted EDXRF spectrum and the corresponding data were then recorded.

Extraction of Crude Extracts from *Kigelia africana* Fruits

Dried powder sample (100 g) was percolated with 800 mL of different solvents such as PE, EtOAc and 95 % EtOH for one week and filtered. The residue was then percolated with different solvents for one week and filtered. The same procedure was repeated twice. The combined filtrate was concentrated under a vacuum rotatory evaporator. The dry filtrate was transferred to a weighed porcelain basin and evaporated to dryness in steam bath to obtain different crude extracts.

For H₂O soluble extractable matter, the dried powder sample (100 g) was boiled with distilled water (100 mL) for 2 hours. The extract was then filtered and transferred to a weighed porcelain basin and evaporated to dryness in a steam bath. The dried filtrate was placed in the oven and maintained at constant weight at 100 °C. The contents of crude extracts in grams per 100 grams of various solvents are presented in Table 4. Some crude extracts were used for the determination of some bioactivities such as antioxidant and cytotoxicity bioassay.

Investigation of Antioxidant Activity of Crude Extracts from *Kigelia africana* Fruits by DPPH Free Radical Scavenging Assay

The free radical scavenging activity of crude extracts from the fruit sample measured using DPPH (2, 2-diphenyl-1-picrylhydrazyl) free radical scavenging assay. DPPH radical scavenging activity of 95 % EtOH, EtOAc and H₂O extracts from the fruit sample was determined by UV-visible spectrophotometer (Marinova and Batchvarov, 2011). The control solution was prepared by mixing 0.002% DPPH solutions (1.5 mL) and 95 % EtOH (1.5 mL) in the brown

bottle using vortex mixer. Similarly, a blank solution was also prepared by mixing the sample solution (1.5 mL). The sample solution was also prepared by mixing the sample solution (1.5 mL) with 0.002 % DPPH solution (1.5 mL). All these solutions were allowed to stand at room temperature for 30 min. Then, the absorbance was measured at $\lambda_{\max}$ 517 nm and recorded on UV-Visible spectrophotometer. Absorbance of individual solution was measured in triplicate and % inhibition of each sample solution was calculated by using the following formula:

$$\% \text{ RSA} = [A_{\text{control}} - (A_{\text{Sample}} - A_{\text{Blank}}) / A_{\text{control}}] \times 100$$

Where,

%RSA = % radical scavenging activity of test sample

A_{control} = absorbance of control solution (DPPH + EtOH)

A_{Sample} = absorbance of sample solution (Sample + DPPH)

A_{Blank} = absorbance of blank solution (Sample + EtOH)

The antioxidant power (IC_{50}) is expressed as the test substances concentration ($\mu\text{g/mL}$) that results in a 50 % reduction of initial absorbance of DPPH solution and that allows to determine the concentration. IC_{50} (50 % inhibitory concentration) values were calculated by linear regressive excel program. The standard deviation was also calculated by the following equation.

$$\text{Standard Deviation (SD)} = \sqrt{\frac{(\bar{x}-x_1)^2 + (\bar{x}-x_2)^2 + \dots + (\bar{x}-x_n)^2}{(n-1)}}$$

Where,

$\bar{x}$ = Average % inhibition

$X_1, X_2, \dots, X_n$ = % inhibition of test sample solution

n = number of times

Investigation of Cytotoxicity of *Kigelia africana* Fruits by Brine Shrimp Lethality Bioassay

The brine shrimp (*Artemia salina*) was used in this study for cytotoxicity bioassay. They were purchased as brine shrimp cysts from a pet shop, Baho Road, Hlaing Township, Yangon Region. Brine shrimp cysts (0.5 g) were added to 1 L of the prepared artificial seawater. The bottle was placed near a lamp and supplied O_2 for 24 hours. After 27 hours of incubation, hatching of brine shrimp cysts occurred and the alive brine shrimp (nauplii) were ready to be used for cytotoxicity test.

Artificial seawater (9 mL) and (1 mL) of different concentrations of samples and standard solutions were added to each chamber of an ice tray. Alive brine shrimp (10 nauplii) were taken with a pasteur pipette and placed into each chamber. They were incubated at room temperature for about 24 h. After 24 h, the number of dead or surviving brine shrimp was counted and 50 % of lethality dose (LD_{50}) was calculated (Dockery and Tomkins, 2000). The control solution was prepared as the above procedure by using 1 mL of distilled water instead of the sample solution and standard solution. The cytotoxicity of different doses of the tested sample was then studied.

Results and Discussion

Phytochemical Investigation of *Kigelia africana* Fruits

The phytochemical investigation of *Kigelia africana* fruits revealed the presence of alkaloids, α -amino acids, carbohydrates, phenolic compounds, tannins, saponins, glycosides, flavonoids, terpenoids, steroids and reducing sugars but starch was not detected. These results are summarized in Table 1.

Table 1. Results of Preliminary Phytochemical Investigation of *Kigelia africana* Fruits

No.	Test	Extracts	Test reagents	Observation	Result
1.	Alkaloids	1 % HCl	Mayer's reagent	White ppt	+
			Dragendorff's reagent	Orange ppt	+
			Wagner's reagent	Brown ppt	+
			Sodium picrate	Yellow ppt	+
2.	α -Amino acids	H ₂ O	Ninhydrin reagent	Purple spot	+
3.	Carbohydrates	H ₂ O	10 % α -Naphthol & Conc: HCl	Red ring	+
4.	Glycosides	H ₂ O	10 % Lead acetate solution	Brown ppt	+
5.	Phenolic compounds	H ₂ O	1 % FeCl ₃ solution	Deep blue colour solution	+
6.	Saponins	H ₂ O	Distilled water	Foaming	+
7.	Starch	H ₂ O	1 % I ₂ solution	Unchanged colour	-
8.	Tannins	H ₂ O	10 % FeCl ₃ solution	Yellowish brown ppt	+
9.	Flavonoids	EtOH	Mg turning & Conc: H ₂ SO ₄	Red colour mixture	+
10.	Reducing sugars	H ₂ SO ₄	Benedict's solution	Brick-red ppt	+
11.	Steroids	PE	Acetic anhydride & Conc: H ₂ SO ₄	Brown colour solution	+
12.	Terpenoids	CHCl ₃	Acetic anhydride & Conc: H ₂ SO ₄	Red colour solution	+

(+) = Presence

(-) = Absence

(ppt) = Precipitate

Nutritional Values of *Kigelia africana* Fruits

From the nutritional values, it was found that moisture (7.85 %), ash (4.05 %), protein (9.14 %), fiber (27.19 %), fat (0.21%), carbohydrate contents (39.95 %) of *Kigelia africana* were recorded. Energy value of *Kigelia africana* is 198.25 kilocalories in 100 g of sample. As a result, it was observed that fiber and carbohydrates were present as major nutrient in the fruit sample. The results are summarized in Table 2 and Figure 2.

Table 2. Results of Nutritional Values of *Kigelia africana* Fruits

No.	Nutrients	Content (%)
1.	Moisture	7.85
2.	Fat	0.21
3.	Fiber	27.19
4.	Ash	4.05
5.	Protein	9.14
6.	Carbohydrates	39.95
7.	Energy values (kcal/100g)	198.25

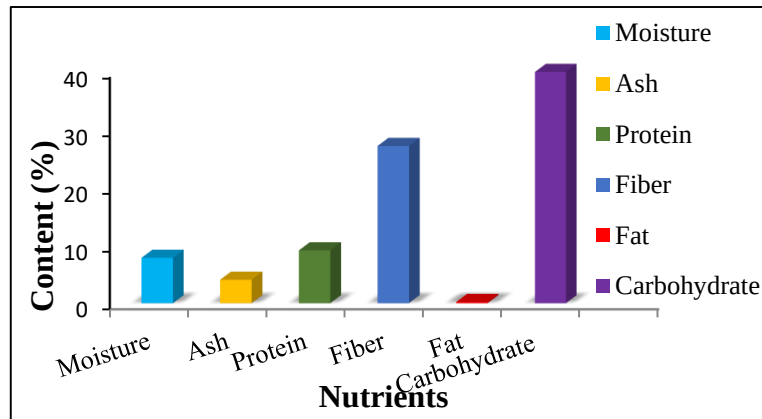


Figure 2. Histograms of nutritional values of *Kigelia africana* fruits

Elemental Compositions in *Kigelia africana* Fruits

Elemental analysis of *Kigelia africana* fruits showed the presence of K, P, Ca, S, Fe, Cu and Zn. The results are described in Table 3 and Figures 3 and 4. From these results, K has the highest content and toxic elements were found to be absent in the fruit sample.

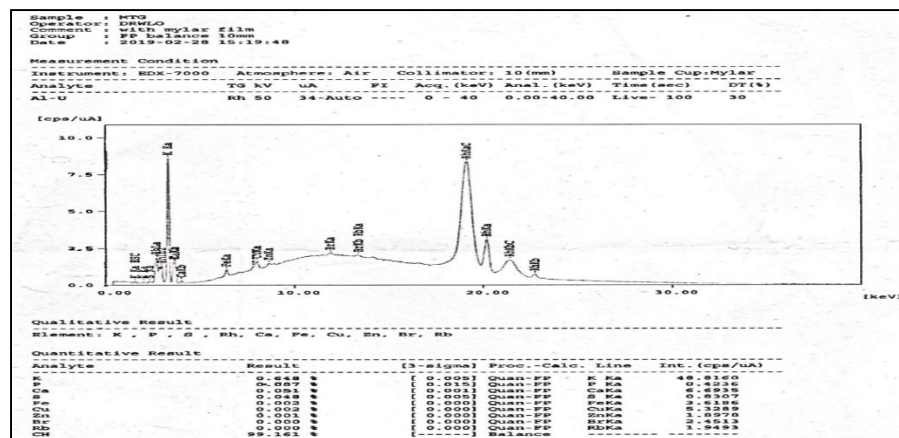


Figure 3. EDXRF spectrum of *Kigelia africana* fruits

Table 3. Relative Abundance of Elements in *Kigelia africana* Fruits from EDXRF Spectrum

No	Elements	Relative Abundance (%)
1.	K	0.648
2.	P	0.087
3.	Ca	0.051
4.	S	0.048
5.	Fe	0.002
6.	Cu	0.002
7.	Zn	0.001

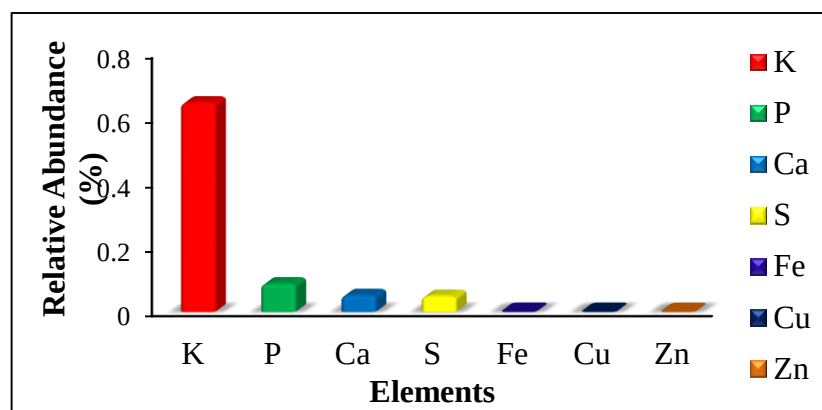


Figure 4. Histogram of relative abundance of elements in *Kigelia africana* fruits

Extraction of Crude Extracts from *Kigelia africana* Fruits

The yield of H₂O extract (22.67 %), 95 % EtOH extract (18.30 %), EtOAc extract (8.32 %) and PE extract (0.47 %) from *Kigelia africana* fruits were obtained. Among the crude extracts, yield percent of H₂O extract was found to be the highest and PE extract was the lowest. Therefore, the chemical constituents in the fruit was more soluble in polar solvents. The resultant contents for four extracts are shown in Table 4.

Table 4. Yield Percent of Crude Extracts from *Kigelia africana* Fruits

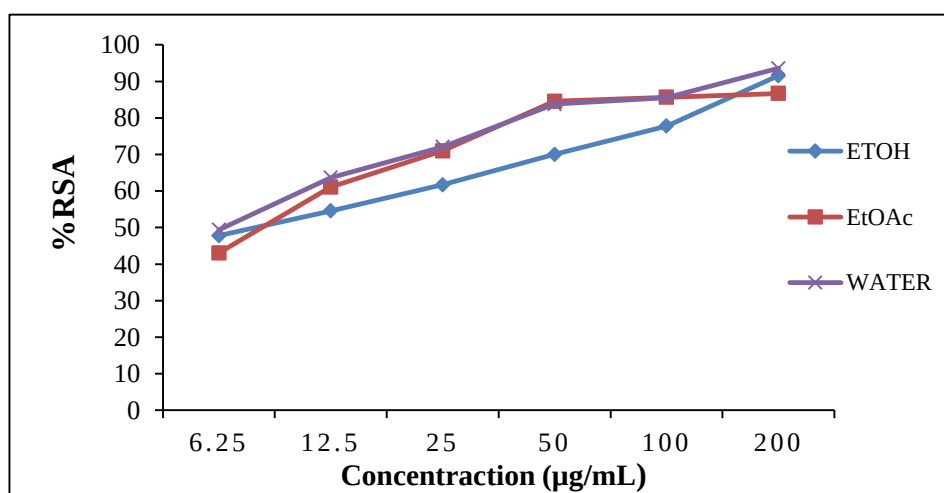
No.	Extracts	Yield percent of crude extracts (% , w/w)
1	H ₂ O	22.67
2	95 % EtOH	18.30
3	EtOAc	8.32
4	PE	0.47

Antioxidant Activity of Crude Extracts from *Kigelia africana* Fruits

The absorbance values of different concentrations (200, 100, 50, 25, 12.5 and 6.25 µg/mL) of tested sample were measured at 517 nm using UV-visible spectrophotometer. It was found that the concentrations were increased, the absorbance values were decreased. The larger the % RSA indicates the higher antioxidant activity. In contrast, the lower the IC₅₀ indicates the more effective antioxidant activity. The antioxidant activity expressed as % radical scavenging activity (% RSA) and 50 % inhibition concentration (IC₅₀) value were calculated by linear regressive excel program. The resultant average % RSA and IC₅₀ values of three crude extracts and standard absorbic acid were described in Table 5 and Figures 5 and 6. From the experimental results, *Kigelia africana* fruits were found to have antioxidant activity. IC₅₀ values of EtOH, H₂O and EtOAc extracts were 6.23 µg/mL, 6.51 µg/mL and 8.66 µg/mL respectively. So, IC₅₀ value of ethanol extract was found to possess the highest antioxidant activity compared to the other extracts.

Table 5. Radical Scavenging Activity (% RSA) and IC₅₀ Values of Different Crude Extracts from *Kigelia africana* Fruits and Standard Ascorbic Acid

Samples	% RSA±SD						IC ₅₀ (µg/mL)
	% Inhibition in different concentrations (µg/mL)						
	6.25	12.5	25	50	100	200	
EtOH	49.570	84.192	89.432	92.697	96.821	97.594	6.32
	±	±	±	±	±	±	
	0.0317	0.0047	0.000	0.0050	0.0011	0.0040	
H ₂ O	49.399	63.66	72.079	83.763	85.567	93.557	6.51
	±	±	±	±	±	±	
	0.0006	0.0089	0.0106	0.0026	0.0326	0.0114	
EtOAc	43.041	61.082	70.962	84.536	85.653	86.684	8.66
	±	±	±	±	±	±	
	0.045	0.0062	0.0045	0.0035	0.0051	0.0074	
Ascorbic Acid	34.361	53.859	62.379	66.870	72.751	82.509	2.25
	±	±	±	±	±	±	
	0.00	0.00	0.00	0.00	0.00	0.00	

**Figure 5. A plot of % RSA Vs concentration of crude extracts from *Kigelia africana* fruits**

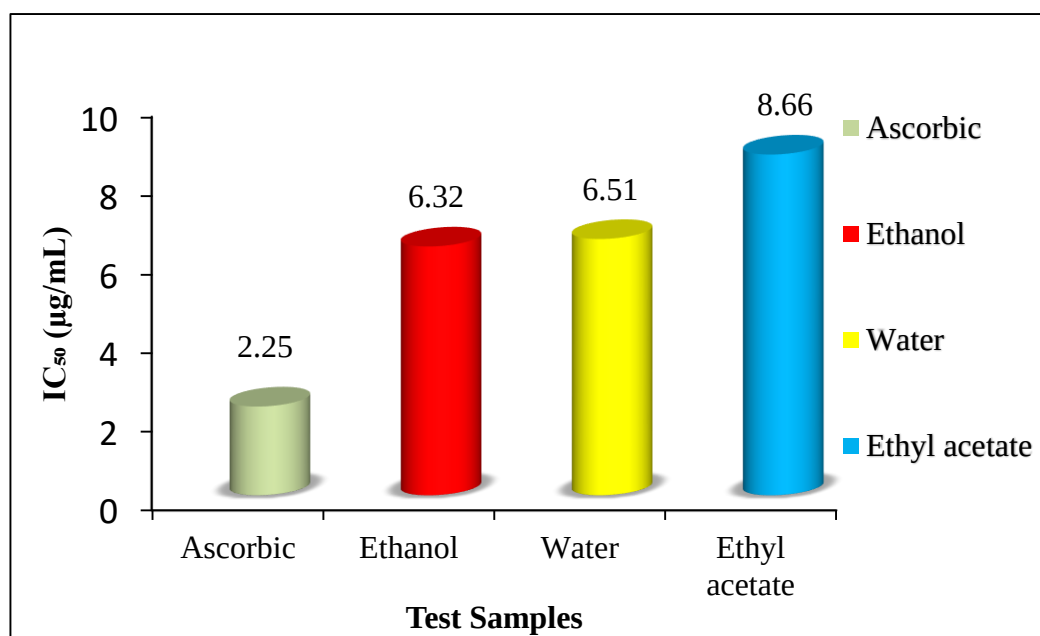


Figure 6 IC₅₀ values of crude extracts from *Kigelia africana* fruits and standard ascorbic acid

Table 6 Cytotoxic Effect of EtOH and H₂O Crude Extracts of *Kigelia africana* Fruits at Difference Concentrations Against *Artemia Salina* (Brine Shrimp Assay)

Sample	% of Dead Brine Shrimp in Different Concentrations of Sample				IC ₅₀ (µg/mL)
	1	10	100	1000	
EtOH	33.3	40	46.7	86.7	243.71
H ₂ O	26.6	40	46.7	96.7	237.27
K ₂ Cr ₂ O ₇ *	40.33	40	56.67	100.00	55.01
Caffeine*	0	0	0	0	>1000

* Used as Cytotoxicity Standard

Cytotoxicity of *Kigelia africana* Fruits

The cytotoxicity of EtOH and H₂O extracts of *Kigelia africana* fruits were evaluated by brine shrimp cytotoxicity bioassay. The organisms used were brine shrimp (*Artemia salina*). The cytotoxicity effect was expressed as IC₅₀ values (50 % Lethality dose). In this experiment, potassium dichromate (K₂Cr₂O₇) and caffeine were used as standard. Potassium dichromate is generally used as the positive control for this brine shrimp bioassay and caffeine, a natural product and artificial sea water, as negative control. The nauplii were counted against a lighted background after 24-hour initiation of test. The cytotoxicity of EtOH and H₂O extracts of the fruits at different concentrations (1000, 100, 10 and 1 µg/mL) are shown in this Table 6. The cytotoxicity of EtOH and H₂O extracts of *Kigelia africana* fruits on brine shrimp were nearly equal with IC₅₀ values of 243.71 µg/mL and 237.27 µg/mL respectively. Standard caffeine did not show cytotoxicity until 1000 µg/mL concentration whereas IC₅₀ value of cytotoxic standard K₂Cr₂O₇ was showed 55.01 µg/mL. So, both extract samples have no cytotoxic effect compared with standard K₂Cr₂O₇.

Conclusion

The phytochemical investigation of *Kigelia africana* fruits revealed the presence of alkaloids, α-amino acids, carbohydrates, phenolic compounds, tannins, saponins, glycosides, flavonoids, terpenoids, steroids and reducing sugars but starch was not detected. From the result, the fruit sample revealed the presence of medically active compounds. The nutritional values indicated that *Kigelia africana* fruits were rich sources of fiber and carbohydrates. According to EDXRF spectrum, it was found that K has the highest content. Among the crude extracts, yield percent of H₂O extract was found to be the highest and PE extract was the lowest. Therefore, the chemical constituents of *Kigelia africana* fruits were more soluble in polar solvents. From the experimental results, IC₅₀ values of EtOH, H₂O and EtOAc extracts were 6.23 µg/mL, 6.51 µg/mL and 8.66 µg/mL respectively. So, IC₅₀ value of EtOH extract was found to possess the highest antioxidant activity compared to the other extracts. Therefore, this study revealed that the extracts of fruit sample may be used as a natural source of antioxidant to prevent the progression of many diseases. The cytotoxicity of ethanol and water extracts of the fruit sample on brine shrimp were nearly equal with IC₅₀ values of 243.71 µg/mL and 237.27 µg/mL respectively. Cytotoxic standard caffeine did not show cytotoxicity effect until 1000 µg/mL concentration whereas the IC₅₀ value of cytotoxic standard K₂Cr₂O₇ was 55.01 µg/mL. So, both extract samples have no cytotoxic effect compared with standard K₂Cr₂O₇. The research indicated that *Kigelia africana* fruits have a good source of many constituents with different pharmacological activities and can be used as a source of alternative medicine.

Acknowledgements

I would like to thank the Department of Higher Education (Lower Myanmar), Ministry of Education, Yangon, Myanmar, for the permission of doing this research and East Yangon University Research Journal for allowing the writing of this paper. My deepest gratitude is expressed to Dr Nay Win Oo, Rector, Dr Aye Aye Ko, Dr Wah Wah Lwin and Dr Thida Aung, Pro-Rectors, East Yangon University for allowing to present this paper. I also greatly indebted to Dr Myo Myo Myat, Professor and Head, Dr Than Than Oo and Dr Myint Myint May, Professors, Department of Chemistry, East Yangon University, for their invaluable advice and encouragement and permission to carry out this research work.

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INVESTIGATION OF CALCIUM IN MILK SAMPLE BY SPECTROPHOTOMETRIC METHOD BY USING ARSENAZO III REAGENT

Ye Yint Naing¹, Myint Aung²

Abstract

In this research, the micro molar level of calcium concentration in milk sample was studied by using arsenazo III reagent. Arsenazo III reagent is a fluently one of the most promising indicator dyes. The stoichiometric ratio and stability constants of calcium-arsenazo III complex was determined by using UV-vis spectrophotometry. Firstly, the effect of pH on arsenazo III reagent was studied by using phosphate buffer solution at different pH values. The absorption spectra were recorded between the wavelength of 400 to 800 nm. The maximum absorbance at 532 nm was obtained at pH 6.6. The formation of calcium-arsenazo III complex was studied in different pH of phosphate buffer solution. The standard calibration curve for calcium-arsenazo III complex solution obey the Beer's law. The stoichiometric ratio of calcium ion to arsenazo III was determined by the mole ratio method. It was found that 1:1 complex was formed. The standard calibration curve, absorbance vs. the concentration of Ca^{2+} was plotted for the determination of calcium ion in cow milk sample. The value of calcium content in milk sample was found to be 106.57 ppm by using the arsenazo III reagent. The Atomic absorption spectroscopy (107.50 ppm) was used to check the result obtained from spectrophotometric method using arsenazo III reagent the value was observed that (107.50 ppm). There is no significant between the two results.

Keywords: Arsenazo III, calcium, stoichiometric ratio, mole- ratio method, milk sample, atomic absorption spectroscopy

Introduction

Most metal ions react with electron pair donors to form coordination compound or complexes (Cotton *et al.* 1980). A complex ion formed by the combination of a simple ion with other ions or with molecules may or may not dissociate in solution into its component parts (Quagliano, 1959). The donor species or ligand must have at least one pair of unshared electrons available for bond formation. Water, ammonia and halide ions are common inorganic ligands. In fact, most metal ions in aqueous solution actually exist as aquo complex. The number of covalent bonds that a cation tends to form with electron donors is its coordination number. Typical values for coordination number are two, four and six. The species formed as a result of coordination can be electrically positive, neutral or negative. Titration based on complex formation sometimes called complexometric titration have been used for more than a century. A chelate is produced when group of a single ligand to form a five or six membered heterocyclic ring. The reagent arsenazo III (1,8 – dihydronaphthalene. 3, 6-disulphonic acid, - 2, 7 - bis (azo-2) phenylarsonic acid gives marked color reactions with a number of elements. Especially useful and universally applicable are reagents containing the arsonous group – ASO_3H_2 . Arsenazo III is a dark-red powder, soluble in water or in weak acid. The most obvious function of calcium is to provide rigidity to the skeleton by virtue of the insoluble salts it forms with phosphoric acid (Cotton *et al.* 1995). A characteristic function of Ca^{2+} ions in living systems is the activation of a variety of metabolic processes. Calcium plays a vital role in heart action, blood clotting muscle contraction and nerve impulse transmission (Chang, 1996).

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Materials and Methods

Determination of the Absorption Spectra of Arsenazo III Solutions at Various pH Values

Each 2 mL of 50 μM Ar III solutions was taken into six separate test tubes containing 2 mL of each buffer solution with different pH values 6.2, 6.4, 6.6, 6.8, 7.0 and 7.2. Then the solution was diluted with 1 mL of distilled water and mixed well. The spectra of these solutions were recorded within the wavelength range of 400–800 nm.

Wavelength of Maximum Absorption of Calcium-Arsenazo III Complex Solution at Various pH

0.1 mL of calcium chloride solution (2×10^{-2} M) was taken by 1 mL graduated pipette into a test tube containing 4 mL of arsenazo III solution (20 μM) at pH 6.6. The solution was mixed well and then 0.9 mL of distilled water was added to the test tube. Other solutions were prepared as the same manner at different pH values 6.2, 6.4, 6.6, 6.8, 7.0, 7.2 and 7.4. The maximum absorption of wavelength of Ca^{2+} - Ar III complex was determined by using UV-visible spectrophotometer.

Determination of the Absorption Spectra of Free Arsenazo III Solutions and Calcium-Arsenazo III Complex Solution at pH 6.6

4 mL of 50 μM arsenazo III solution was taken by pipette into a test tube containing 1 mL of distilled water. This solution was mixed well. The solution was taken by pipette into the cell and absorption spectra of solution was record between 400 – 800 nm. Then 0.1 mL of calcium chloride (2×10^{-2} M) solution was taken by a test tube containing 4 mL of arsenazo III solution (50 μM) at pH 6.6. The solution was mixed well and then 0.9 mL of distilled water is added to the test tube. The absorption spectra of the sample solution were also recorded between the wavelength ranges of 400 - 800 nm and distilled water was used as the reference solution.

Determination of Stoichiometric Ratio of Calcium-Arsenazo-III Complex by Mole Ratio Method

Each 2 mL of 50 μM arsenazo III solution was placed in nine separate test tube containing 2 mL of phosphate buffer solution at pH 6.6. Then 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8 and 0.9 mL of (1×10^{-4} M) calcium chloride solution was added into the separate test tubes to give solutions having metal ion to ligand, mole ratio of 0.25:1, 0.5:1, 0.75:1, 1:1, 1.25:1, 1.5:1, 1.75:1, 2:1 and 2.25:1. Each mixture was mixed well and the volume made up to 5 mL with distilled water. A plot of the absorbance against with mole ratio of calcium to arsenazo III was constructed at 598 nm.

Calibration Curve for Calcium-Arsenazo III Complex Solution

1 mL of phosphate buffer solution was added into the each of six separate test tubes and 0.5, 1.0, 1.5, 2.0, 2.5 and 3.0 mL of arsenazo III solution (1×10^{-4} M) were also added into respective test tubes. Then 0.1, 0.2, 0.3, 0.4, 0.5 and 0.6 mL of calcium chloride solution (5×10^{-4} M) was added into above test tubes. The volume of the solution mixture was made up to 5 mL with distilled water and the solutions were mixed well. The absorption spectra of calcium arsenazo III complex solutions at different concentrations were measured at wavelength of 598 nm.

Preparation of Milk Digest Solution

10 mL of milk sample was added into 100 mL conical flask containing 20 mL of nitric acid and 3.5 mL of hydrogen peroxide. 30 mL of distilled water were also added to the conical flask. The solution was shaken well at 300 °C from time to time and then the solution was filtered by filter paper and the clear solution was obtained. The clear solution was made up volume to 100 mL with distilled water and the digest solution was obtained.

Determination of Trace Level of Calcium in Milk Sample by Using Arsenazo III Solution

0.5 mL of milk digested solution and 2 mL buffer solution was added to a test tube containing 6 mL of arsenazo III solution (1×10^{-4} M) and 1.5 mL of water. 2.5 mL of this mixture solution was transferred into the cell. Then 5 μ L of calcium chloride solution were added into cell. The absorption spectra of the sample solutions were recorded between the wavelength ranges of 400 - 800 nm.

Results and Discussion

The Absorption Spectra of Arsenazo III Solution at Various pH

In the present work, the absorption spectra of free arsenazo III solution at various pH values of 6.2, 6.4, 6.6, 6.8, 7.0 and 7.2 were recorded between the wavelength range of 400 to 800 nm (Table 1 and figure 1). The absorbances at $\lambda_{\max}$ varies with solution pH. The arsenazo III solution at pH 6.6 phosphate buffer showed the highest absorbance at 532nm.

Table 1 Relation between Absorbance and Wavelength of Free Arsenazo III Molecule at Different pH Values

pH	Wavelength	Absorbance
6.2	532.0	0.425
6.4	528.0	0.405
6.6	532.0	0.428
6.8	530.0	0.423
7.0	532.0	0.417
7.2	530.0	0.416

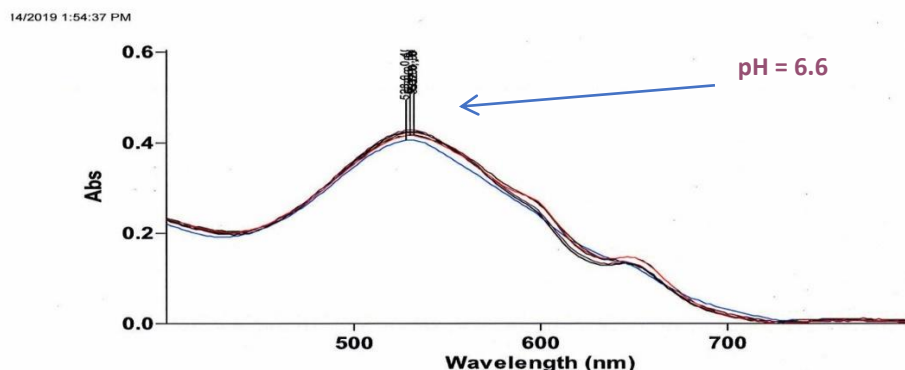


Figure 1. UV-visible absorption spectra of free arsenazo III solution (20 μ M) at various pH values

Wavelength of Maximum Absorption of Calcium-Arsenazo III Complex Solution at Various pH

For quantitative analysis in spectroscopic study, it is necessary to determine the wavelength of maximum absorption (Vogel, 1964). The absorption spectra of calcium – arsenazo III complex at various pH of 6.2, 6.4, 6.6, 6.8, 7.0, 7.2, and 7.4 were recorded between the wavelength range of 400-800 nm (Table 2 and figure 2). The absorption spectra are different from that of free arsenazo III ligand. The highest absorbance was found in the pH 6.6 solution. There are three wavelength of maximum absorption, 652, 598, and 562 nm. λ_{max} (598 nm) concerned with the calcium- arsenazo III ligand absorption. For detailed study, the complex formation was carried out at pH 6.6 phosphate buffer solution. The concentration of arsenazo III solution is 50 μM and the concentration of calcium ion solution is 40 μM .

Table 2. Relation between Absorbance and Wavelength of Calcium-Arsenazo III Complex at Different pH Values

pH	Wavelength	Absorbance
6.2	534.0	0.381
6.4	530.0	0.395
6.6	532.0	0.407
6.8	534.0	0.402
7.0	530.0	0.400
7.2	532.0	0.397
7.4	530.0	0.256

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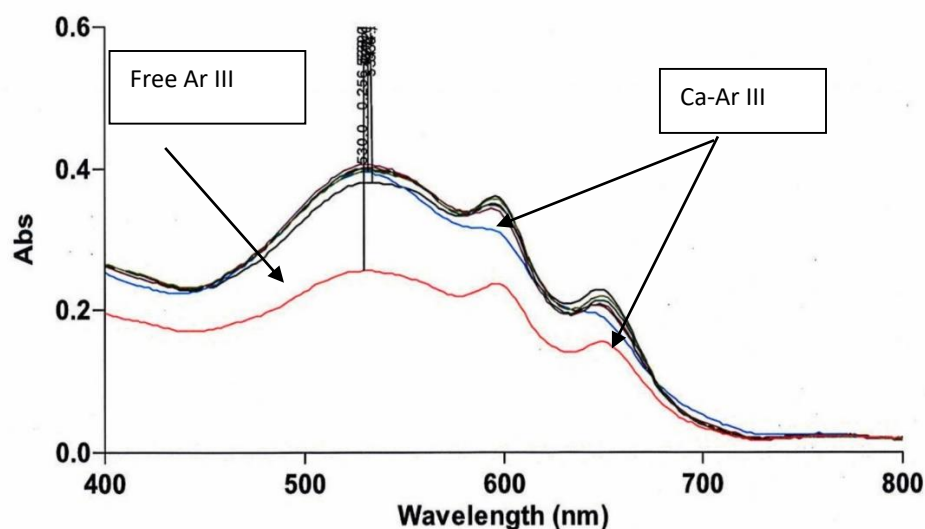


Figure 2. UV-vis absorption spectra of calcium-arsenazo III complexes at various pH values

Wavelength of Maximum Absorption of Free Ligand Arsenazo III and Calcium – Arsenazo III Complex Solution at pH 6.6

In the present work, the concentrations of arsenazo III and calcium ion were kept constant at 20 μM and the complex formation were studied by using pH 6.6 phosphate buffer solution. The absorption spectra of the free ligand and complex solutions were recorded between the wavelength ranges of 400-800 nm. The λ_{max} of free arsenazo III was found at 532 nm, whereas λ_{max} of calcium- arsenazo III was found at 598 nm with higher absorbance. This indicated the strong complexation between arsenazo III and Ca^{2+} ion.

Table 3. Relation between Absorbance and of Wavelength of Free Arsenazo III and Calcium-Arsenazo III Complex at pH 6.6

Wavelength	Absorbance	
	Free Arsenazo III	Ca-Ar III complex
556.0 nm	0.591	0.947
598.0 nm	1.012	1.041
652.0 nm	0.970	0.614

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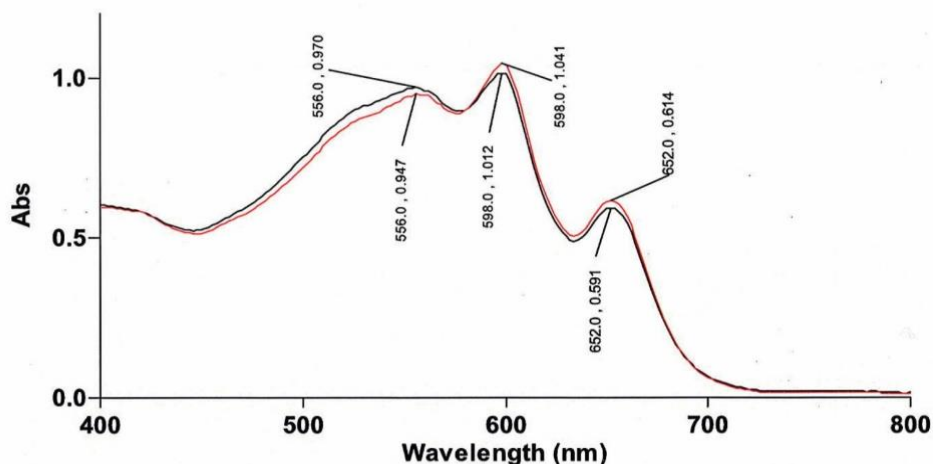


Figure 3. UV-visible absorption spectra for free arsenazo (III) and (calcium – arsenazo III) complex at pH 6.6

Stoichiometric Composition of Calcium- Arsenazo III Complex

In the present work, the stoichiometric ratios of calcium ion to arsenazo III were determined by the mole ratio method. In mole ratio method, series of solution is prepared in which the analytical concentration of one reactant is held constant while that of the other is varied. The concentration of arsenazo III solution was kept constant at 20 μM while the concentration of calcium ion was varied in the range of 10 to 60 μM . After preparing the solutions, the absorbance of the complex solutions was measured at 598 nm against distilled water as a blank and the plot of absorbance vs. mole ratio of calcium ion and arsenazo III solutions were drawn. The two straight

lines intersected at a mole ratio that corresponds to the combining ratio in this complex. It can be seen that the intersection point is at the metal ion to ligand mole ratio of about 1.00 implying that the stoichiometric ratio of calcium and arsenazo III reagent.

Table 4. Relationship between the Absorbance of the Calcium-Arsenazo III Complex at 598 nm and Mole Ratio of Calcium to Arsenazo III (50 μ M)

Mole ratio Ca^{2+} -Ar III complex	Absorbance
0.25:1	0.951
0.50:1	0.961
0.75:1	0.968
1.00:1	0.975
1.25:1	0.975
1.50:1	0.975
1.75:1	0.977
2.00:1	0.977
2.25:1	0.977

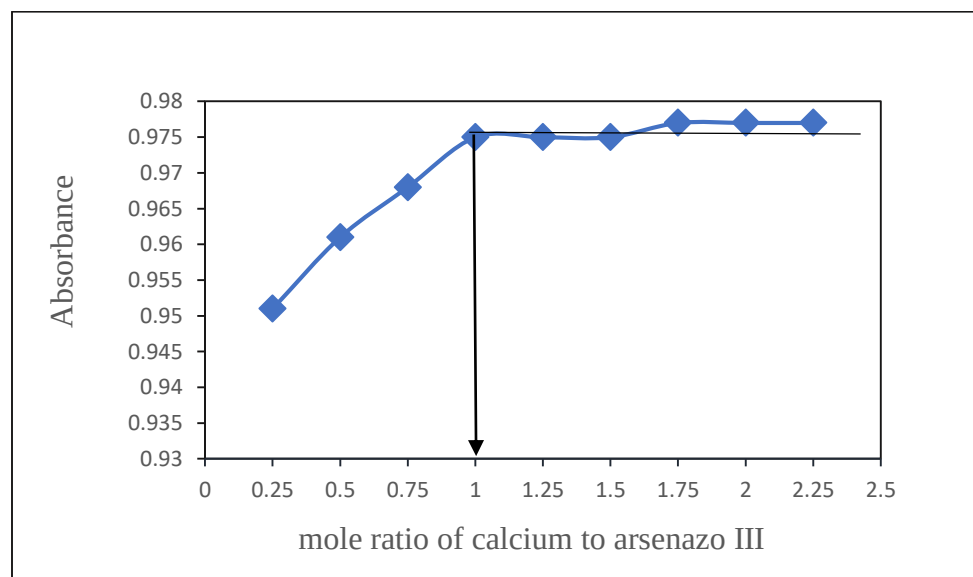


Figure 4. Plot of the absorbance of the complex at 598 nm as a function of mole ratio of Ca to arsenazo III

Calibration Curve for Calcium –Arsenazo III Complex Solution

The calibration curve for calcium – arsenazo III complex solution was plotted by using the absorbance of complex solution at 598 nm and the calcium ion solution in various concentrations (10 - 60 μ M). The concentration of arsenazo III solution was kept constant at 40 μ M. The nature of the calibration curve reveals a straight line passing through the origin implying that Lambert – Beer's law was obeyed so that the concentration ranges of calcium ion solution (10 - 60 ppm) was chosen as the working range. calcium to arsenazo III was 1: 1. So the stoichiometric ratio of calcium to arsenazo III was found to be 1:1 in the phosphate buffer system at pH 6.6.

Table 5. Relationship between the Absorbance and Ca^{2+} Ion Concentration in Calcium –Arsenazo III Complex Solution

Ca^{2+} ion Concentration (μ M)	Absorbance at 598 nm
10	0.4184
20	0.5629
30	0.6631
40	0.8099
50	1.0749
60	1.2483

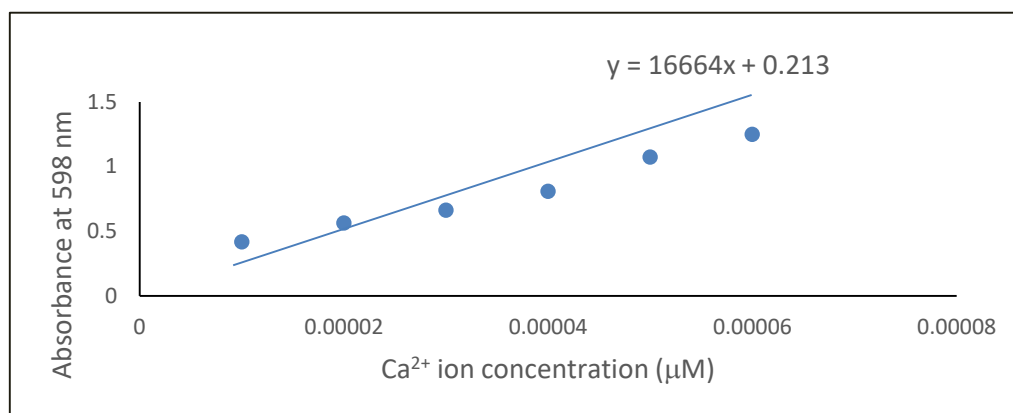


Figure 5. Absorbance against Ca^{2+} ions concentration in Ca-Arsenazo III complex at 598nm

Trace Level of Calcium in Milk Sample by Using Arsenazo III Ligand

The determination of free calcium in solution is important in many biological, clinical, environmental, and agricultural systems. The amount of calcium in milk sample was calculated from standard comparison method. In this research, the amount of calcium in milk samples was 106.57 ppm for 10 mL of digest milk, agreement with the literature value of 1000 ppm for milks. The calcium content in milk sample was also determined by atomic absorption spectrophotometric method and the result was found to be 107.50 ppm respectively. The calcium content obtained from two methods nearly the same.

Conclusion

Firstly, the effect of pH on arsenazo III reagent was studied by using phosphate buffer solution of pH values 6.2, 6.4, 6.6, 6.8, 7.0 and 7.2. The absorption spectra were recorded between the wavelength of 400 to 800 nm. The absorption spectra varied with increasing pH values of phosphate buffer solution. The maximum absorbance at 532 nm was obtained at pH 6.6. So, the absorption spectra of arsenazo III in solution were strongly pH dependent. The formation of calcium–arsenazo III complex was studied at different phosphate buffer solution at pH values of 6.2, 6.4, 6.6, 6.8, 7.0, 7.2, and 7.4. The absorption spectra of calcium–arsenazo III complexes were recorded between the wavelength ranges of 400 to 800 nm. Formation of calcium–arsenazo III complex is also pH dependent. The maximum wavelength of calcium–arsenazo III complex was found at 598 nm. At pH 6.6, the standard calibration curve for calcium–arsenazo III complex solution was constructed by using different concentrations of calcium ion solution at 598 nm. The stoichiometric ratio of calcium ion to arsenazo III was determined by the Mole Ratio method and indicated the 1:1 complex. The standard calibration curve, A_{complex} vs. the concentration of Ca^{2+} ion calcium -arsenazo III complex in was plotted for the determination of calcium ion in cow milk samples. Calcium ion concentration was found to be 106.57 in cow milk sample. By checking AAS method the value calcium ion was observed that 107.50 ppm. Therefore, these two values are nearly identical from two different methods.

Acknowledgements

We would like to thank the Department of Higher Education (Lower Myanmar), Ministry of Education, Yangon, Myanmar, for the permission of doing this research and writing of this paper. Our deepest gratitude is expressed to Dr Nay Win Oo, (Rector), Dr Aye Aye Ko, Dr Wah Wah Lwin and Dr Thida Aung, (Pro-Rectors), East Yangon University for allowing to present this paper. We also greatly indebted to Dr Myo Myo Myat, Professor and Head, Dr Than Than Oo and Dr Myint Myint May, Professors, Department of Chemistry, East Yangon University, for their invaluable advice and encouragement.

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DETERMINATION OF FERROUS ION CHELATING ACTIVITY OF *HYLOCEREUS UNDATUS* (DRAGON FRUIT) AND *CARICA PAPAYA* LINN. (PAPAYA FRUIT)

Thet Thet Swe*

Abstract

In the present study, *Hylocereus undatus* (white dragon fruit) and *Carica papaya* Linn. (papaya fruit) were used to investigate antioxidant activity. Antioxidant activity of the *Hylocereus undatus* and *Carica papaya* Linn. were measured by determination of ferrous ion chelating activity. Chelating power measures the effectiveness of compounds in sample solutions to compete with ferrozine for ferrous ion. The results revealed that pulp of *Carica papaya* displayed the highest ferrous ion chelating activity at all concentrations, followed by the fruit (peel and pulp) of *Hylocereus undatus*. Peel of *Carica papaya* showed the least ferrous ion chelating activity. It was observed that a gradual increment of chelating activity as the concentration of the fruit extract increased. Pulp of papaya was found to be a good source of antioxidant agent for iron chelator.

Keywords: *Hylocereus undatus*, *Carica papaya* Linn., ferrozine

Introduction

Antioxidant is a molecule that inhibits oxidation of other molecules. Oxidation reaction can produce free radicals that can cause chain reactions. When the chain reaction occurs in a cell, it can cause damage or death to the cells. Antioxidants stop this cellular chain reaction of oxidation by neutralizing the free radicals. Metal ions (Fe, Cu) can catalyze the production of $\text{OH}^\bullet$. Reaction of ferrous ion with hydrogen peroxide generates the hydroxyl radical, which oxidizes the surrounding biomolecules.



Metal chelators such as EDTA deactivate Cu, Fe by the formation of complex ion or coordination compounds. Fruits can be rich sources of various vitamins, minerals and fibers required by human body for optimal health. Epidemiological studies have shown that high fruit intake can be associated with reduced mortality and morbidity of cardiovascular diseases and some types of cancer one possible mechanism is attributed to the antioxidant activity. Fruits are diverse in antioxidant composition and those with high antioxidant activity generally contain more antioxidants. The classic antioxidants are vitamin C, E and β -carotene. Other antioxidants include phenolic compounds which have been identified as important antioxidants found in fruits. Some of these compounds have been shown to have even more antioxidant activity than vitamin C and E in vitro and significant bioavailability has been demonstrated by animal and human studies (Valvi *et al.*, 2011).

Antioxidants are substances that can prevent or delay oxidative damage of lipids, proteins and nucleic acids by reactive oxygen species, which include reactive free radicals such as superoxide, hydroxyl, peroxy, alkoxyl and non-radicals such as hydrogen peroxide, hypochlorous, etc. They scavenge radicals by inhibiting initiation and breaking chain propagation or suppressing formation of free radicals by binding to the metal ions, reducing hydrogen peroxide, and quenching superoxide and singlet oxygen. The most abundant antioxidants in fruits are polyphenols and vitamin C, vitamin A, B and E and carotenoids are present to a lesser extent in some fruits. These polyphenols, most of which are flavonoids, are present mainly in ester and glycoside forms. In this

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study, *Hylocereus undatus* (white dragon fruit) and *Carica papaya* Linn. (papaya fruit) were chosen for determination of ferrous ion chelating activity (Nurliyana *et al.*, 2010).

Since the later part of the nineteenth century, organic molecules containing atomic configuration, namely $-N=C-C=N-$, have been known to react as bidentate ligands with certain metal ions such as ferrous, cuprous, and cobaltous, to give colored complex species. This effect was first noticed with the ferrous ion, and since this complex of a given compound is generally of a more intense color than are those with other ions. The atomic configuration in question was given the trivial name of the ferriox group. During the last century, hundreds of compounds containing the ferriox group have been synthesized, the majority of which demonstrate the ability to form complexes with the ferrous ion (Stookey *et al.*, 1970). Ferrozine is used as the chelator. Fe(II) in solution complexes very strongly with ferrozine and the complex has a strong purple color between pH 4 and 9.5. Visible light absorption at 562 nm is used to measure the concentration of the complex. Absorption is linear, so a single standard can be used for a wide range of concentration.

Hylocereus undatus (white dragon fruit) is fruit belonging to the family name of Cactaceae (Cactus family). This plant is widely grown around the world in tropical regions. Dragon fruit is very high in antioxidants, and help boost the immune system. Dragon fruit is rich in carbohydrates, protein, calcium, iron and phosphorus. It also provides large amounts of niacin (vitamin B₃) and ascorbic acid (vitamin C). The fruit is rich in water and fiber. Eat dragon fruit as a good natural source of antioxidants which help to prevent the dangers of free radicals which can cause cancer. Calcium and phosphorus found in dragon fruit can make bones stronger and healthier teeth. Dragon fruit also has benefit to cure cough and asthma to treat high blood pressure (Choo and Yong, 2011).

Carica papaya Linn. (papaya fruit) is fruit belonging to the family name of Caricaceae. This plant is commonly found in Central and South America and most parts of Myanmar. The fruits, leaves and seeds of papaya are used medicinally and other purposes. Papaya has high nutritional benefits. It is rich in antioxidants, the B vitamins, folate and pantothenic acid and the minerals, potassium and magnesium and fiber. Papaya fruits are also a good source of fiber, which has been shown to lower high cholesterol levels. Papaya is a natural remedy for aiding digestion and constipation. Ripe papaya is usually eaten raw. Ripe fruit eats for laxative effect (Maisarh *et al.*, 2013).

The objective of the present study was to investigate the antioxidant properties of fruit *Hylocereus undatus* (peel and pulp) and *Carica papaya* Linn. (peel and pulp). Antioxidant contents of the *Hylocereus undatus* and *Carica papaya* Linn. were measured by determination of ferrous ion chelating activity (Choo and Yong, 2011).

Materials and Methods

Samples and Chemicals

The sample of *Hylocereus undatus* (white dragon fruit) and *Carica papaya* Linn. (papaya fruit) were obtained from local markets, Maha Aung Myay Township, Mandalay. The collected samples were identified by authorized botanists, Department of Botany, University of Mandalay. Ferrozine was purchased from KEMIKO Chemical Co. Ltd (Yangon, Myanmar). Ferrous chloride used in this experiment was provided from Department of Chemistry, University of Mandalay.

Botanical Aspects of Dragon Fruit



Figure 1. Dragon plant and fruit

Scientific name	- <i>Hylocereus undatus</i>
Family name	- Cactaceae
English name	- Dragon Fruit
Myanmar name	- Nagarr-mauk thee
Part used	- Peel and Pulp

Botanical Aspects of Papaya Fruit



Figure 2. Papaya plant and fruit

Scientific name	- <i>Carica papaya</i> Linn.
Family name	- Caricaceae
English name	- Papaya Fruit
Myanmar name	- Thin-baw thee
Part used	- Peel and Pulp

Sample Preparation

Sample of fruits (peels and pulps) for *Hylocereus undatus* (white dragon fruit) and *Carica papaya* Linn. (papaya fruit) were prepared. The two fruits were washed and wiped dry. All fruits were cut into a few portions. The portions (40 g) were crushed to a paste-like state for approximately 2 min (with intermittent stops to minimize heating) using a blender. The homogenized sample was transferred into a 100 mL volumetric flask and 50 % ethanol was added up to the mark. The mixture was shaken manually for 10 min, followed by centrifugation at 1500 rpm. The extracts were stored in a refrigerator. All tests were performed within a week.

Determination of Ferrous Ion Chelating Activity

100 μ L of 0.001 M FeCl_2 was added to 2 mL of sample solution. The reaction was initiated by the addition of 200 μ L of ferrozine solution (0.0025 M). The mixture was vigorously shaken and left to stand at room temperature for 10 min. The absorbance of the solution was measured at λ_{max} 562 nm (Nurliyana *et al.*, 2010).

$$\% \text{ inhibition of ferrozine -Fe}^{2+} = \frac{A_o - A_s}{A_o} \times 100$$

A_o = the absorbance of the control

A_s = the absorbance of the solution in the presence of sample

Results and Discussion

Ferrous Ion Chelating Activity Assay

Free ferrous ion is quite sensitive to oxygen and gives rise to ferric ion and superoxide and generates hydrogen peroxide. Reaction of ferrous ion with hydrogen peroxide generates the hydroxyl radical, which oxidizes the surrounding biomolecules. In this process, known as the Fenton reaction, hydroxyl radical production is directly related to the concentration of copper or iron. Chelating power measures the effectiveness of compounds to compete with ferrozine for ferrous ion. A high chelating power extract reduces the free ferrous ion concentration by forming a stable iron (II) chelate and thus decreasing the extent of Fenton reaction which is implicated in many diseases (Choo and Yong, 2011).

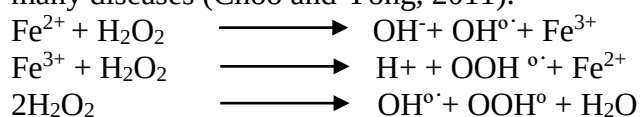


Table 1. Ferrous Ion Chelating Activity of Peel of Dragon Fruit

No.	Concentration of extract (mg/mL)	Chelating activity (%)
1.	250	30.1
2.	200	30.1
3.	150	30.1
4.	100	26.9
5.	75	25.4
6.	50	12.3
7.	25	5.9

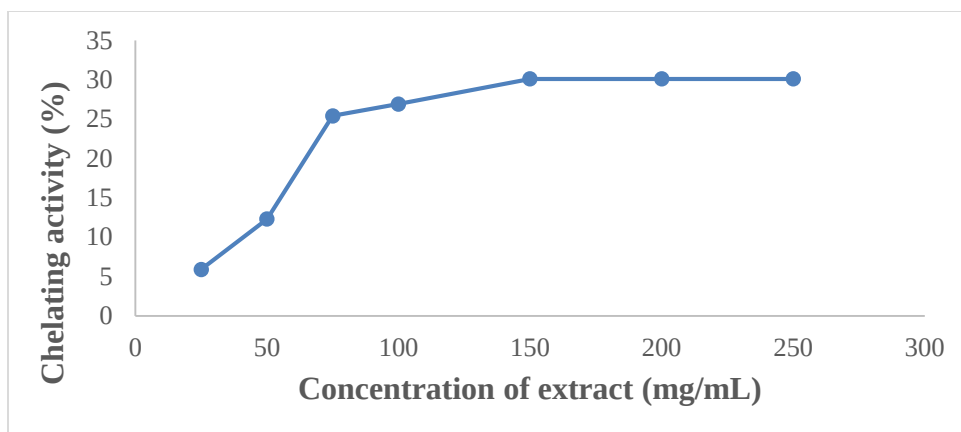


Figure 3. A plot of chelating activity *versus* concentration of dragon fruit peel extract

This figure 3 showed the percent chelating activity of peel of dragon fruit at various concentrations. As shown in the table 1, the highest ferrous ion chelating activity of peel of dragon fruit was 30.1 % at the concentration of 150 mg/mL.

Table 2. Ferrous Ion Chelating Activity of Pulp of Dragon Fruit

No.	Concentration of extract (mg/mL)	Chelating activity (%)
1.	400	30.1
2.	350	30.1
3.	300	30.1
4.	200	24.7
5.	150	19.7
6.	100	13.1
7.	75	10.2
8.	50	4.2

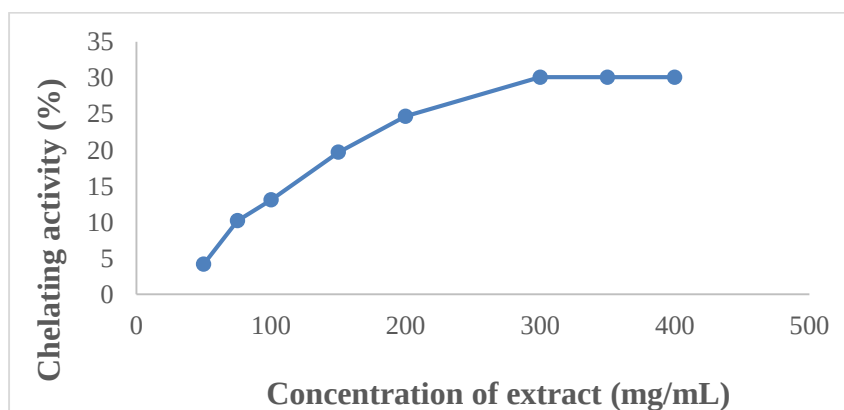


Figure 4. A plot of chelating activity *versus* concentration of dragon fruit pulp extract

This figure 4 showed the percent chelating activity of pulp of dragon fruit at various concentrations. As shown in the table 2, the highest ferrous ion chelating activity of pulp of dragon fruit was 30.1 % at the concentration of 300 mg/mL.

Table 3. Ferrous Ion Chelating Activity of Peel of Papaya Fruit

No.	Concentration of extract (mg/mL)	Chelating activity (%)
1.	300	11.6
2.	200	6.5
3.	150	5.1
4.	100	1.2
5.	75	0.3
6.	50	0.18

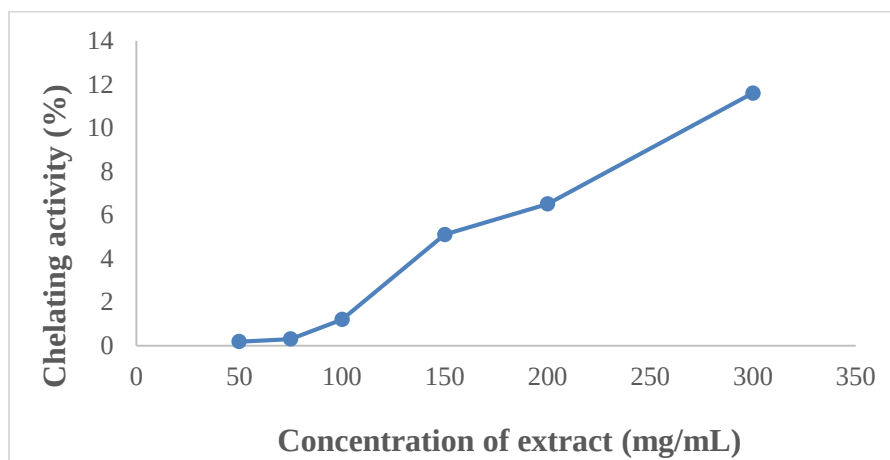


Figure 5. A plot of chelating activity versus concentration of papaya fruit peel extract

This figure 5 showed the percent chelating activity of peel of papaya fruit at various concentrations. As shown in the table 3, the highest ferrous ion chelating activity of peel of papaya fruit was 11.6 % at the concentration of 300 mg/mL.

Table 4. Ferrous Ion Chelating Activity of Pulp of Papaya Fruit

No.	Concentration of extract (mg/mL)	Chelating activity (%)
1.	150	30.1
2.	100	30.1
3.	75	30.1
4.	50	22.1
5.	25	10.6
6.	12.5	4.5
7.	6.25	2.1

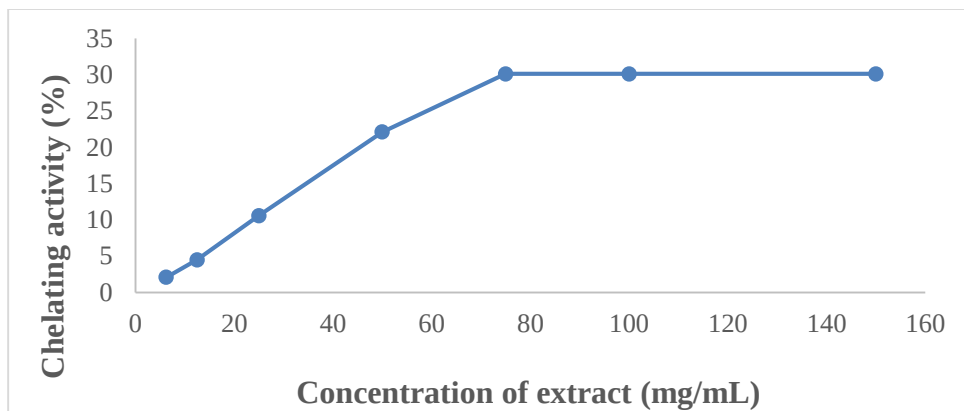


Figure 6. A plot of chelating activity versus concentration of papaya fruit pulp extract

This figure 6 showed the percent chelating activity of pulp of papaya fruit at various concentrations. As shown in the table 4, the highest ferrous ion chelating activity of pulp of papaya fruit was 30.1 % at the concentration of 75 mg/mL.

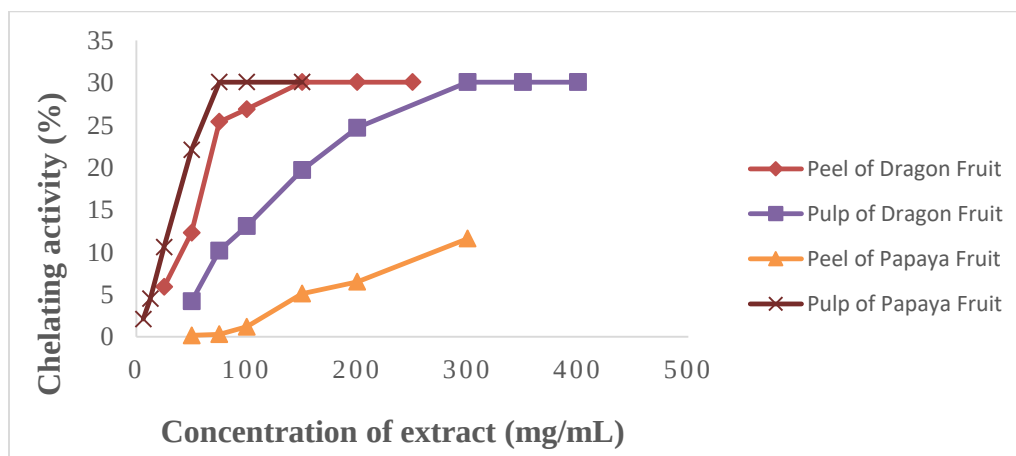


Figure 7. A plot of chelating activity versus concentration of dragon fruit and papaya fruit peel and pulp extract

The ferrous ion chelating activity ranked in the following order: Pulp of papaya fruit > Peel of dragon fruit > Pulp of dragon fruit > Peel of papaya fruit. The pulp of papaya fruit showed that the highest ferrous ion chelating activity followed by peel and pulp of dragon fruit and the peel of papaya fruit showed that the least ferrous ion chelating activity. It was also observed that a gradual increment of chelating activity as the concentration of the fruit extract increased (Choo and Yong, 2011). Dragon fruit can be eaten as a good natural source of antioxidants which help to prevent the dangers of free radicals which can cause cancer and other undesirable health detriments. Because of high antioxidant content in pulp of papaya, it can prevent cholesterol oxidation and can be used in a preventative treatment against atherosclerosis, strokes, heart attacks and diabetic heart disease. The papaya fruits may be eaten regularly to get health benefits from them.

Conclusion

In this study, *Hylocereus undatus* (white dragon fruit) and *Carica papaya* Linn. (papaya fruit) were used to investigate antioxidant activity. Antioxidant contents of the dragon fruit and papaya fruit were measured by determination of ferrous ion chelating activity. The results revealed that pulp of papaya fruit displayed the highest ferrous ion chelating activity followed by the fruit (peel and pulp) of dragon fruit. Peel of papaya fruit showed the least ferrous ion chelating activity. The ferrous ion chelating activity ranked in the following order: Pulp of papaya fruit > Peel of dragon fruit > Pulp of dragon fruit > Peel of papaya fruit. It was observed that a gradual increment of chelating activity as the concentration of the fruit extract increased. Pulp of papaya was found to be a good source of antioxidant agent for iron chelator.

Acknowledgements

I would like to express my sincere thanks to Rector Dr Nay Win Oo, Pro-Rectors Dr Aye Aye Ko, Dr Wah Wah Lwin, and Dr Thida Aung, East Yangon University, for advice and encouragement to conduct this paper. Dr Myo Myo Myat, Professor and Head, Dr Than Than Oo, and Dr Myint Myint May, Professors, Department of Chemistry, East Yangon University, are also to be appreciated for enabling me to submit my paper and for their many helpful suggestions.

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INVESTIGATAION ON PHYTOCHEMICAL CONSTITUENTS, NUTRITIONAL VALUES AND ELEMENTAL ANALYSIS OF NEEM (*AZADIRACHTA INDICA* A. JUSS) AND FERMENTED NEEM LEAVES

Theingi Lwin¹, Dr Lay Khine²

Abstract

Azadirachta indica is a very useful traditional medicinal plant because it has an invaluable medicinal purpose. This study was designed to examine phytochemical constituents, nutritional values and elemental analysis of *Azadirachta indica*. The preliminary phytochemical tests revealed that alkaloids, carbohydrates, flavonoids, glycosides, phenolic compounds, reducing sugars, saponins, starch, steroids and tannins were found to be present in the neem leaves and fermented neem leaves whereas cyanogenic glycosides were absent. The α -amino acids were present in neem leaves sample but not in fermented neem leaves sample. Nutritional values of *Azadirachta indica* determined by AOAC method, were moisture content (4.86 %, 8.31 %), ash content (8.29 %, 3.77 %), protein content (15.05 %, 20.29 %), fiber content (10.15%, 10.00 %), fat content (5.51 %, 7.30 %), carbohydrate content (19.85 %, 20.20 %) and energy value of 189.19 kcal/100g and 227.66 kcal/100g of neem leaves and fermented neem leaves. Elemental contents of two samples were studied by EDXRF spectrometer. In elemental analysis, K, Ca, Si, Sr, S, Fe, Br, Cu, Zn, Mn, Rb and Ti were found to be in the neem leaves sample and Ca, Sr, K, Fe, S, Cu, Zn and Mn were observed in the fermented neem leaves sample. The content of K is the highest in neem leaves sample and Ca is the highest in fermented neem leaves sample. Neem leaves could also serve as a good source of nutritional supplement in the diet of humans and animals. The plant may be useful in the treatment of hypokalemia, to reduce blood pressure and to improve bone health.

Keywords: *Azadirachta indica*, phytochemical constituents, nutritional values, elemental analysis

Introduction

Neem (*Azadirachta indica*) is one of the most useful traditional medicinal plants. Neem (*Azadirachta indica*) of family meliaceae is evergreen tree of potential medicinal value found in most tropical countries. Neem tree has a strong place in the world of medicine and wellness. Every part of the neem plant can be used against various infectious diseases. Most of the parts of the plant contain compounds with proven antiseptic, antiviral, antipyretic, anti-inflammatory, antiulcer and antifungal properties (Kritikar and Basu, 1991).

The chemical constituents contain many biologically active compounds that can be extracted from neem, including alkaloids, flavonoids, tri-terpenoids, phenolic compounds, carotenoids, steroids and ketones other compounds that have a biological activity are salannin, volatile oils, meliantriol and nimbin (Jacobson, 1990). Neem is considered harmless to humans, animals, birds, beneficial insects and earth worms, and has been approved by the US Environmental Protection Agency for use on food crops.

Neem (*Azadirachta indica*)

Neem (*Azadirachta indica*) also called nim or margosa, fast-growing tree of the mahogany family (Meliaceae), valued as a medicinal plant, as a source of organic pesticides, and for its timber. Neem is likely native to the Indian subcontinent and to dry areas throughout South Asia. It has been introduced to parts of Africa, the Caribbean, and numerous countries is South and

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Central America. The plant has long been used in Ayurvedic and folk medicine and is used in cosmetics and in organic farming applications.

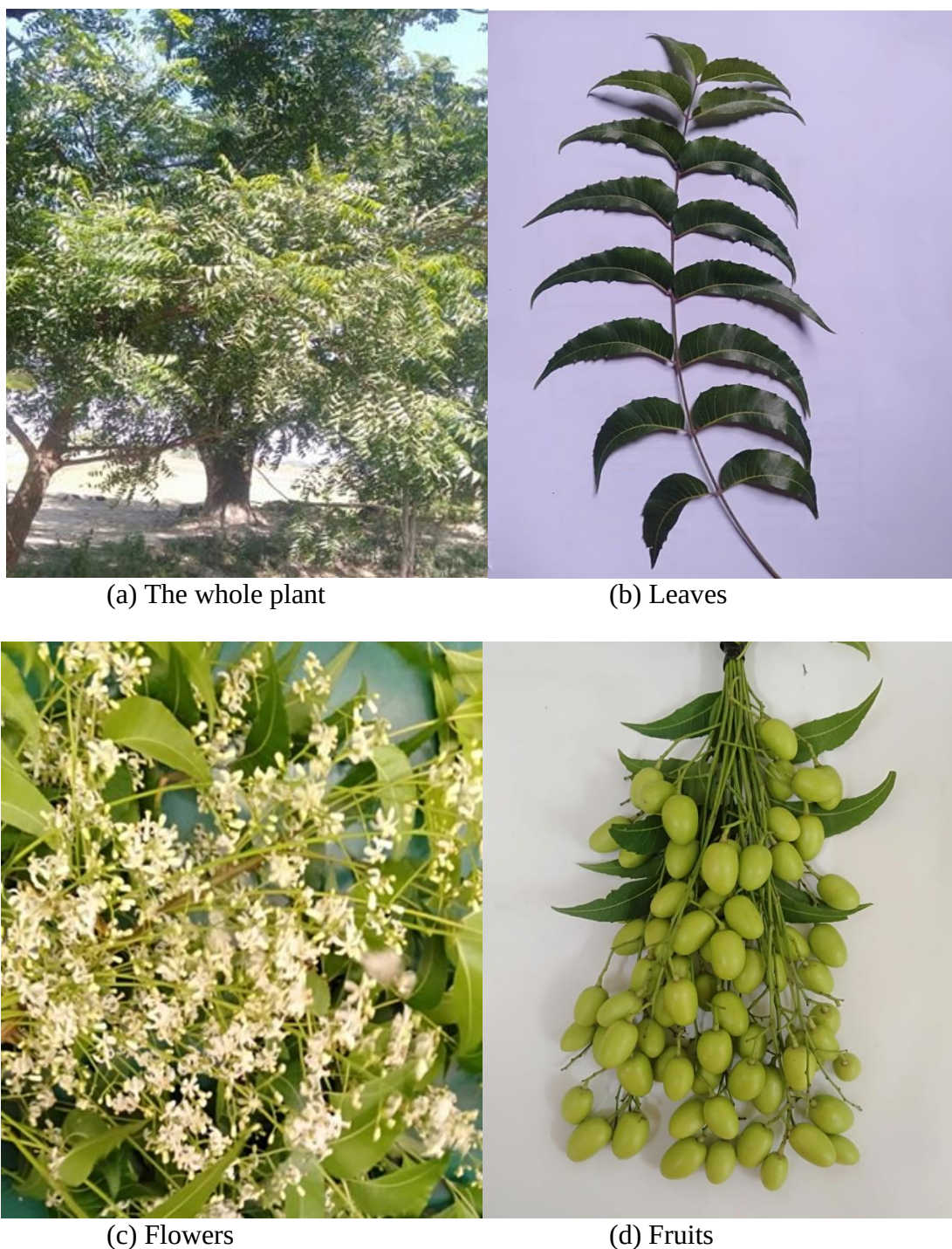


Figure 1. Photographs of neem (*Azadirachta indica*)
(a) The whole plant (b) Leaves (c) Flowers (d) Fruits

Botanical Description of Neem (*Azadirachta indica* A. Juss)

Botanical Name	- <i>Azadirachta indica</i> A. Juss
Family Name	- Meliaceae
Common Name	- Neem
English Name	- Neem, Neem Tree, Margosa-tree, Margosa, Indian Lilac
Myanmar Name	- Ta-mar, Ta-mar-kri, Ta-mar-kha

Neem trees can reach 15-30 meters (49-98 feet) in height and have attractive rounded crowns and thick furrowed bark. The compound leaves have toothed leaflets and are typically evergreen but do drop during periods of extreme drought. The small fragrant white flowers are bisexual or staminate (male) and are borne in clusters in the axils of the leaves. The fruit is a smooth yellow-green drupe and has a sweet-flavoured pulp. Neem is usually grown from seed but can be propagated from cuttings or root suckers. The plant is hardy and resilient and grows well in poor, rocky soils. Neem tolerates a wide variety of environmental conditions but cannot survive freezing temperatures or being waterlogged.

Health Benefits of Neem Leaves

Neem leaves are obtained from neem trees (Indian Lilac) that are found throughout India. They are extensively used in making Ayurvedic medicines because of their antibacterial, anti-inflammatory and antifungal properties. Neem leaves contain nimbin, nimbolide, nimandial and over 130 various biologically active compounds that help in the treatment of skin and gum diseases, detoxifies blood and helps in skin toning, reducing acne, promote a healthy respiratory and digestive system, nourish hair.

Neem contains vitamin C which is essential for skin related problems like acne, blackheads, pigmentation, dullness and ageing. Neem leaves are very good for those with sensitive or oily, acne-prone skin. Neem is rich in vitamin C, and stimulates collagen production and infuses the skin with antioxidants to protect against free radicals. Collagen production reduces the appearance of fine lines and wrinkles, keeping the skin smooth, healthy, and vibrant.

Removes toxins	: Since ages neem leaves have been known for their cleansing properties. A concoction of neem leaves can remove toxins from the body.
Good for Bones	: Neem is rich in calcium and thus good for bones. A massage of neem oil on the joints can relieve the arthritic pain and reduces inflammation.
Iron rich	: Iron is very essential for blood production and a cup of neem gives about 28.47 % of the daily iron requirement.
Antioxidants	: Being rich in antioxidant quercetin and nimbolide, it can protect from free radical damage which otherwise can lead to other health complications like diabetes, heart disease, cancer etc.
Builds Immunity	: Eating neem leaves enhances the immune system. Chew on a handful of cleaned and washed neem leaves daily to keep viral infections at bay.
Good for skin health	: A paste of neem leaves and turmeric powder is effective in reducing skin pigmentation and lightening scars. Neem leaves are often used to make face packs to keep the skin supple and moisturized. A daily consumption of neem leaves also proves to be beneficial for skin.
Hair Health	: Its high antioxidant property makes it suitable to support hair follicle growth. Washing hair with boiled neem water after shampoo is very effective to moisturize the scalp and remove dandruff and lice.
Anti-Bacterial and	: It possesses anti-bacterial properties as well. It kills the unhealthy

- Anti-Fungal** bacteria and thus cleanses the gut. Neem also has anti-fungal properties Which may be helpful in humid climate of India.
- Oral health** : Neem leaves maintain the alkaline level of saliva, fight germs and gives a fresh breath. Neem extracts decrease the microorganisms present in mouth and prevent dental caries.
- Good for diabetes** : A decoction made by boiling neem leaves if consumed daily helps regulate blood sugar levels too. In a study, neem leaf extract and seed oil exerted hypoglycemic effects. It may also be helpful in preventing or delaying the onset of the diabetes (Pillai and Santhakumari, 1981).

Vitamins and Minerals

Vitamins and minerals are essential substances that human bodies need to develop and function normally. The known vitamins include A, C, D, E, and K, and the B vitamins: thiamin (B₁), riboflavin (B₂), niacin (B₃), pantothenic acid (B₅), pyridoxal (B₆), cobalamin (B₁₂), biotin, and folate (folic acid). A number of minerals essential for health are calcium, phosphorus, potassium, sodium, chloride, magnesium, iron, zinc, iodine, sulfur, cobalt, copper, fluoride, manganese, and selenium. The Dietary Guidelines for Americans 2015-2020 recommends that people should aim to meet their nutrient requirements through a healthy eating pattern that includes nutrient-dense forms of foods.

Materials and Methods

Sampling

The fresh plant sample neem leaves (*Azadirachta indica*) were collected from Phayagyi Village, Thongwa Township, Yangon Region in December 2019. These species were identified at Department of Botany, East Yangon University.

The neem leaves (1 kg) were rinsed with water to remove dirt. The cleaned leaves were boiled in 1000 mL of water for 30 minutes to remove bitter flavour. This process was repeated for three times until the neem leaves became clear. Then they were filtered. The boiled neem leaves were mixed with plum (300 g), salt (50 g), turmeric powder (0.25 g approximately) and 3000 mL of rice water in a closed-type bottle. Then the mixture was fermented for about three weeks. The purpose of this process is to see whether the mixture has undergone fermentation. The samples, neem leaves and fermented neem leaves were washed with distilled water, cut into small pieces and air dried at room temperature about eight days. And then, dried samples were powdered by using an electric grinder. The dried powdered was stored in air dry bottle to prevent the moisture change and contamination.

Phytochemical Tests

For the phytochemical tests, both dried powdered samples were carried out by test tube method to indicate the presence or absence of alkaloids, α -amino acids, carbohydrates, cyanogenic glycosides, flavonoids, glycosides, phenolic compounds, reducing sugars, saponins, starch, steroids and tannins (M-Tin Wa, 1972).

Determination of Nutritional Values

Nutritional values of both dried powdered samples for moisture, ash, protein, fat, fiber, carbohydrate were determined by AOAC method (2000). The moisture content was determined by oven-drying method. The ash content was determined by Muffle furnace method. The protein content was determined by micro Kjeldahl's method. The fat content was determined by Soxhlet extraction method. The fiber content was determined by acid-base digestion method. Total

carbohydrates content was determined by UV-visible spectrophotometrically according to phenol sulphuric acid method. The energy values of the sample were calculated using the following equation:

$$\text{Energy value (kcal/100 g)} = (4 \times \text{protein}) + (4 \times \text{carbohydrate}) + (9 \times \text{fat})$$

Elemental Analysis

Both dried powdered samples were analyzed by using Energy Dispersive X-ray Fluorescence (EDXRF) spectrometer (Shimadzu-EDX-7000) at Department of Physics, University of Taungoo.

Results and Discussion

Phytoconstituents

According to the results, phytochemical investigation showed that the neem leaves and fermented neem leaves contained bioactive compounds such as alkaloids, carbohydrates, flavonoids, glycosides, phenolic compounds, reducing sugars, saponins, starch, steroids and tannins. The α -amino acids were present in neem leaves but not in fermented neem leaves. All neem samples had free toxic effects due to the absence of cyanogenic glycosides. The results were shown in Table 1.

Nutritional Values

Nutrients are necessary for life and good health; these may be found in a number of different plants. The general functions of nutrients include fuel (energy) expressed in kcal, building materials for body structures and regulation and control of body processes. As a result, the nutritional values indicated that carbohydrates and protein were present as major nutrients in neem leaves and fermented neem leaves. Nutrients like carbohydrates and protein can help our stay healthy as our age. The results were shown in Table 2 and Figure 2.

Elemental Analysis

In this research work, mineral elements such as content of K is the highest in neem leaves sample and Ca is the highest in fermented neem leaves sample. The level of K and Ca were found to be high as compared to the other elements. Although, small amounts of Mn, Zn and Cu were found in both samples. These all elements are biologically very much important for the skin and other diseases (Sahito *et al.*, 2003). The results were shown in Table 3 and Figures 3, 4, 5 and 6.

Conclusion

In the present research, the preliminary phytochemical tests were determined by test tube method. According to the results, alkaloids, carbohydrates, flavonoids, glycosides, phenolic compounds, reducing sugars, saponins, starch, steroids and tannins were found to be present in the neem leaves and fermented neem leaves whereas cyanogenic glycosides were absent. The α -amino acids were present in neem leaves sample but not in fermented neem leaves sample. Carbohydrates and protein were present as major nutrients in neem leaves and fermented neem leaves. Neem leaves could also serve as a good source for nutritional supplement in the diet of humans and animals. The level of K and Ca were found to be high as compared to the other elements in the samples. The neem leaves can be useful in the treatment of hypokalemia, to reduce blood pressure and to improve bone health.

Table 1. Results of Preliminary Phytochemical Investigation of *Azadirachta indica* (Leaves and Fermented Leaves) by Test Tube Method

No.	Test and Extracts	Test reagents	Observations		Results	
			NL	FNL	NL	FNL
1.	Alkaloids (1% HCl)	Mayer's reagent	Cream	Cream	+	+
		Wagner's reagent	Orange ppt.	Brown ppt.	+	+
		Hager's reagent	Yellow ppt.	Yellow ppt.	+	+
		Dragendorff's reagent	Reddish brown ppt.	Brown ppt.	+	+
		Sodium picrate solution	Yellow ppt.	Yellow ppt.	+	+
2.	α - amino acids (H ₂ O)	Ninhydrin reagent	Purple spot	No colour	+	-
3.	Carbohydrates (H ₂ O)	10 % α -naphthol, Conc: H ₂ SO ₄	Red ring	Red ring	+	+
4.	Cyanogenic glycosides (H ₂ O)	Conc: H ₂ SO ₄ , sodium picrate paper	No colour	No colour	-	-
5.	Flavonoids (EtOH)	Mg ribbon, a few drops of conc: HCl	Deep green colour	Deep green colour	+	+
6.	Glycosides (H ₂ O)	10 % lead acetate solution	Yellow ppt.	Yellow ppt.	+	+
7.	Phenolic compounds (H ₂ O)	5 % FeCl ₃ solution	Greenish black colour	Pale yellow colour	+	+
8.	Reducing sugars (H ₂ O)	Dil NaOH Benedict's solution	Pale green colour	Pale green colour	+	+
9.	Saponins (H ₂ O)	Distilled water	Frothing	Frothing	+	+
10.	Starch (H ₂ O)	I ₂ solution	Reddish brown colour	Reddish brown colour	+	+
11.	Steroids (PE)	Acetic anhydride & H ₂ SO ₄ (conc:)	Green colour	Green colour	+	+
12.	Tannins (H ₂ O)	10 % alcoholic solution of FeCl ₃	Deep green ppt.	Dark Orange ppt.	+	+

NL = Neem Leaves, FNL = Fermented Neem Leaves

(+) = Presence, (-) = Absence, (ppt.) = Precipitate

Table 2. Results of Nutritional Values of *Azadirachta indica* (Leaves and Fermented Leaves)

No.	Nutrients	Contents (%)	
		NL	FNL
1	Moisture	4.86	8.31
2	Ash	8.29	3.77
3	Protein	15.05	20.29
4	Crude Fat	5.51	7.30
5	Crude Fiber	10.15	10.00
6	Carbohydrates	19.85	20.20
7	Energy value (kcal/ 100 g)	189.19	227.66

NL = Neem Leaves, FNL = Fermented Neem Leaves

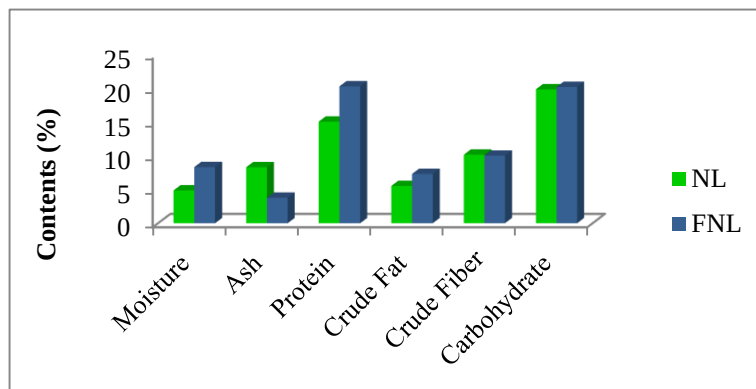
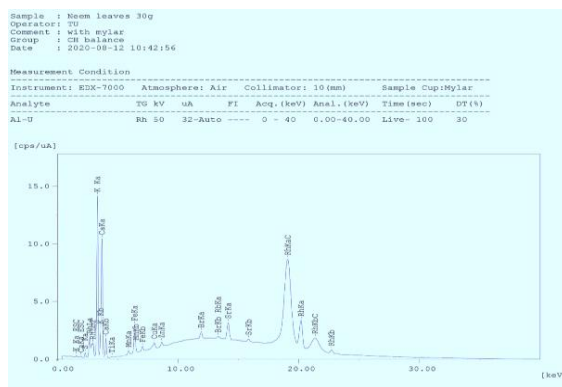
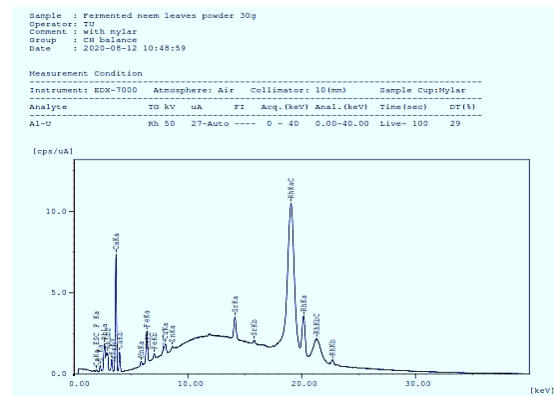
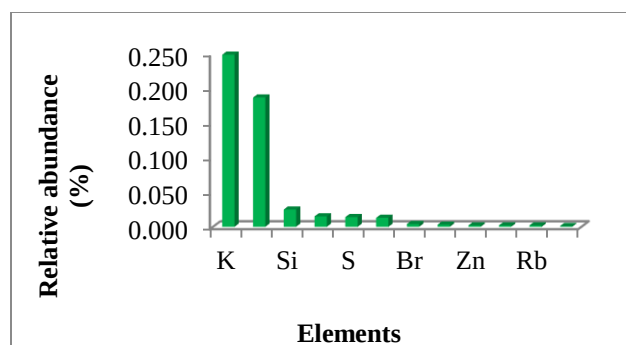
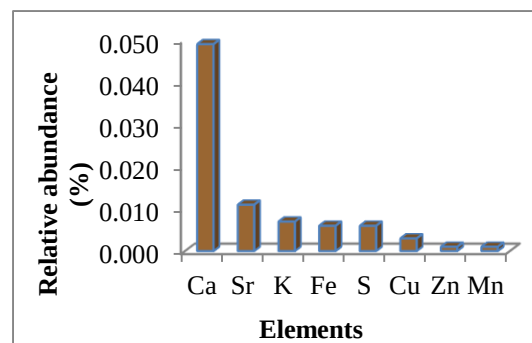
**Figure 2. Nutritional values of *Azadirachta indica* (leaves and fermented leaves)****Figure 3. EDXRF spectrum of neem leaves****Figure 4. EDXRF spectrum of fermented neem leaves**

Table 3. Relative Abundance of Elements in *Azadirachta indica* (Leaves and Fermented Leaves) by EDXRF Method

Elements	Relative Abundance (%)	
	NL	FNL
K	0.249	0.007
Ca	0.187	0.049
Si	0.025	-
Sr	0.015	0.011
S	0.014	0.006
Fe	0.013	0.006
Br	0.004	-
Cu	0.003	0.003
Zn	0.002	0.001
Mn	0.002	0.001
Rb	0.002	-
Ti	0.001	-

NL = Neem Leaves, FNL = Fermented Neem Leaves

**Figure 5. Bar graph of relative abundance of elements in neem leaves****Figure 6. Bar graph of relative abundance of elements in fermented neem leaves**

Acknowledgements

First of all, we wish to express our deepest appreciation and special thanks to Dr Nay Win Oo (Rector), Dr Aye Aye Ko, Dr Wah Wah Lwin and Dr Thida Aung (Pro-Rectors), East Yangon University for their kind permission to submit this paper. We would like to express our sincere gratitude to Professor Dr Myo Myo Myat (Professor and Head), Dr Than Than Oo, and Dr Myint Myint May (Professors), Department of Chemistry, East Yangon University for their encouragement and advice.

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INVESTIGATION OF PHYTOCHEMICAL CONSTITUENTS AND CHARACTERIZATION OF ESSENTIAL OIL FROM *CURCUMA CAESIA* ROXB. (GA MONE TAIN PYAR)

Theingi Wint Thu¹, Kay Khaing Nyunt²

Abstract

This research deals with the investigation of some phytochemical constituents and essential oil from rhizome of *Curcuma caesia* Roxb. The preliminary phytochemical screening of *Curcuma caesia* revealed the presence of alkaloids, α -amino acids, carbohydrates, flavonoids, glycosides, organic acids, phenolic compounds, saponin, starch, tannins, terpenoids but the absence of cyanogenic glycosides, reducing sugars and steroids. The components of essential oil were characterized by GC-MS. From the results, ten components were obtained from essential oil of *Curcuma caesia*, namely eucalyptol, camphor, p-menth-2-en-9-ol, trans, L-alpha-terpineol, alpha-bulnesene, isocaryophyllene, gamma-murolene, benzofuran, 6-ethenyl-4,5,6,7-tetrahydro-3, 6-dimethyl-5-isoprop, gamma-elemene and beta-elemenone.

Keywords: *Curcuma caesia* Roxb., phytochemical constituents, essential oil

Introduction

Curcuma caesia Roxb. (Ga Mone Tain Pyar) is a kind of turmeric with bluish-black rhizome belonging to Zingiberaceae (Ginger) family. *Curcuma caesia* Roxb. is a perennial herb with bluish-black rhizome native to Northeast, Central India and Myanmar. The plant grows only in the rainy season but it dries in other season. However, it can grow in any type of soil like light, well drained, moist, loamy soil, and light to heavy black soil.

The rhizomes of the plant are aromatic in nature. The inner part of the rhizome is bluish-black in colour and emits a characteristics sweet smell due to presence of essential oil (Pandey and Chowdhary, 2003).

The rhizomes of *Curcuma caesia* have a high economical importance because of its putative medicinal properties. The use of plants and medicinal plants has been recommended to combat the effect of free radicals/mutagens because they can induce phase II enzymes reducing the action of initiation, promotion or progression stages of cancer and other degenerative diseases. Also the plants are rich source of secondary metabolites such as flavonoids, phenolics, carotenoids, coumarins, anthraquinones, tannins, terpenoids, saponins that play a prominent role in inhibiting human carcinogenesis and repair the cell mutations (Ruan, 1989). The rhizomes are used in the treatment of smooth muscle relaxant activity (Arulmozhi *et al.*, 2006), haemorrhoids, leprosy, asthma, cancer, epilepsy, fever, wound, vomiting, menstrual disorder, anthelmintic, aphorodisiac, inflammation, gonorrheal discharges, etc. (Sasikumar, 2005). The part of fresh rhizome is applied in case of snake and scorpion bite (Kagyung *et al.*, 2010).

Materials and Methods

Sample Collection and Preparation

Several samples of Ga Mone Tain Pyar collected from Yangon Region, and then it was washed with water. The rhizome was carved into very small pieces and allowed to dry well. The dried pieces were made into powder by using grinding machine. The powdered sample was stored

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in air-tight container to prevent moisture changes and other contaminations. The dried powdered sample was used for chemical investigations.

Botanical Aspects of *Curcuma caesia* Roxb.

Family	:	Zingiberaceae
Genus	:	<i>Curcuma</i>
Species	:	<i>Caesia</i>
Botanical Name	:	<i>Curcuma caesia</i> Roxb.
Myanmar Name	:	Ga Mone Tain Pyar
English Name	:	Black Turmeric
Part used	:	Rhizome



Figure 1 The Rhizome of *Curcuma caesia*.

Preliminary Phytochemical Investigation of Rhizome of *Curcuma caesia* Roxb.

Phytochemical tests for rhizome of *Curcuma caesia* (Ga Mone Tain Pyar) were carried out to determine the presence and absence of phytochemical constituents such as alkaloids, α -amino acids, carbohydrates, cyanogenic glycosides, flavonoids, glycosides, organic acids, phenolic compounds, reducing sugars, saponins, starch, steroids, tannins and terpenoids (M-Tin Wa, 1972).

Extraction of Essential Oil from the Rhizome of *Curcuma caesia* Roxb.

The essential oil from the rhizome of *Curcuma caesia* was extracted by steam distillation method.

Procedure

The sample of the fresh rhizome of *Curcuma caesia* (100 g) was placed in the insert of glass jacket. The glass jacket is filled with distilled water. The glass jacket was fitted to set which was joined to water condenser. When the glass jacket was heated, the condensed oil and water coming out from condenser will collected in the receiver flask. The oil was extracted with n-hexane in a separating funnel. The n-hexane was evaporated at 60-70 °C to get the essential oil which was then weighed until to be constant weight and kept in air tight bottle (Srivastava *et al.*, 2003).

Determination of Organic Compounds in Essential Oil from the Rhizome of *Curcuma caesia* Roxb. by GC-MS Method

Gas chromatography-mass spectrometry (GC-MS) is a method that combines features of gas chromatography and mass spectrometry to identify different substances with a test sample (Robert and Webster, 1998).

Application of GC-MS includes identification and quantitation of volatile and semi-volatile organic compounds in complex mixtures. Organic constituents in essential oils from the rhizome of *C.caesia* were detected by GC-MS Spectroscopic Method at National Analytical Laboratory, Department of Research and Innovation.

Results and Discussion

Preliminary Phytochemicals Results of the Rhizome of *Curcuma caesia* Roxb. by Test Tube Method

The preliminary phytochemical tests were done on the rhizome with a view to determine the presence or absence of alkaloids, α -amino acids, carbohydrates, cyanogenic glycosides, organic acids, flavonoids, glycosides, phenolic compounds, reducing sugars, saponin, starch, steroids, tannins and terpenoids. All bioactive compounds are present except cyanogenic glycosides, steroids and reducing sugars. The results were shown in Table 1.

Table 1 **Phytochemical Results of Rhizome of *Curcuma caesia* Roxb.**

(+) = presence, (-) = absence, (ppt.) = precipitate

No.	Tests	Extract	Test reagents	Observation	Result
1	Alkaloids	1 % HC1	Dragendorff's reagent	Orange ppt.	+
			Mayer's reagent	White ppt.	+
			Wagner's reagent	Reddish brown ppt.	+
			Sodium picrate reagent	Yellow ppt.	+
2	α -amino acids	H ₂ O	Ninhydrin reagent	Pink colour	+
3	Carbohydrates	H ₂ O	10 % α -Naphthol, Conc:H ₂ SO ₄	Red ring	+
4	Cyanogenic glycosides	H ₂ O	Sodium picrate Conc:H ₂ SO ₄	No Brick red colour	—
5	Flavonoids	EtOH	Mg turning, Conc: HC1	Pink colour	+
6	Glycosides	H ₂ O	10 % Lead acetate solution	White ppt.	+
7	Organic acids	H ₂ O	Bromocresol blue indicator	Blue colour	+
8	Phenolic compounds	EtOH	5 % FeCl ₃ solution, 1 % potassium ferrocyanide	Dark blue colour	+
9	Reducing sugars	H ₂ O	Benedict's solution	No Brick red ppt.	—
10	Saponins	H ₂ O	Distilled water	Frothing	+
11	Starch	H ₂ O	1% Iodine solution	Blackish blue	+
12	Steroids	PE	Acetic anhydride, Conc: H ₂ SO ₄	No Greenish blue colour	—
13	Tannins	EtOH	1 % Gelatin, 5 % FeCl ₃ solution	Green ppt.	+
14	Terpenoids	CHCl ₃	Acetic anhydride, Conc: H ₂ SO ₄	Pink colour	+

Characterization of Organic Compounds in Essential Oil from the Rhizome of *Curcuma caesia* Roxb. by GC-MS

Gas chromatographic mass spectrometry (GC-MS) is the single most important tool or identification of unknown organic compounds by matching with reference spectra. Identifications were made by comparison of their retention time and m/z ratio indicates with private reference library data and from literature.

Table 2. Chemical Compositions of Essential Oil from the Rhizome of *Curcuma caesia*.

No	Compounds from <i>Curcuma caesia</i> R.	Compounds from <i>Curcuma</i> Species *	Molecular Weight	Molecular Weight (Literature value)*	Retention Time
1	Eucalyptol	Eucalyptol	154	154	5.78
2	Camphor	Camphor	152	152	9.823
3	<i>p</i> -menth-2-en-9-ol, trans		154		10.54
4	L- α -terpineol	L- α -terpineol	154	154	12
5	Alpha-bulnesene	Alpha-bulnesene	204	204	22.29
6	Isocaryophyllene	Isocaryophyllene	204	204	24.58
7	Gamma-murolene		204		26.48
8	Benzofuran, 6-ethyl-4,5,6,7-tetrahydro-3,6-dimethyl-5-isoprop	Benzofuran, 6-ethyl-4,5,6,7-tetrahydro-3,6-dimethyl-5-isoprop	216	216	26.99
9	Gamma-elemene	Gamma-elemene	204	204	28.46
10	Beta-elemenone	Beta-elemenone	218	218	30.97

Dasoky, 2018

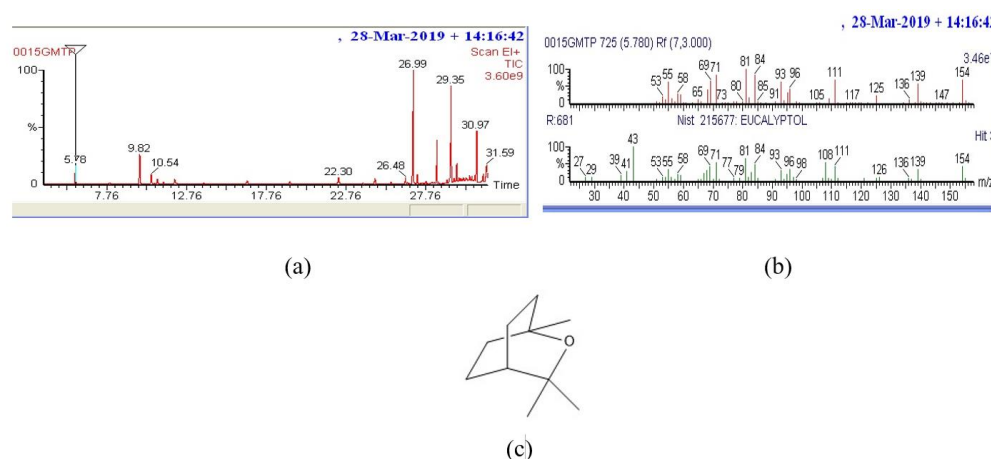


Figure 2. GC-MS chromatograms of eucalyptol from the rhizome of *Curcuma caesia* according to (a) retention time and (b) mass to charge ratio (c) structure of eucalyptol

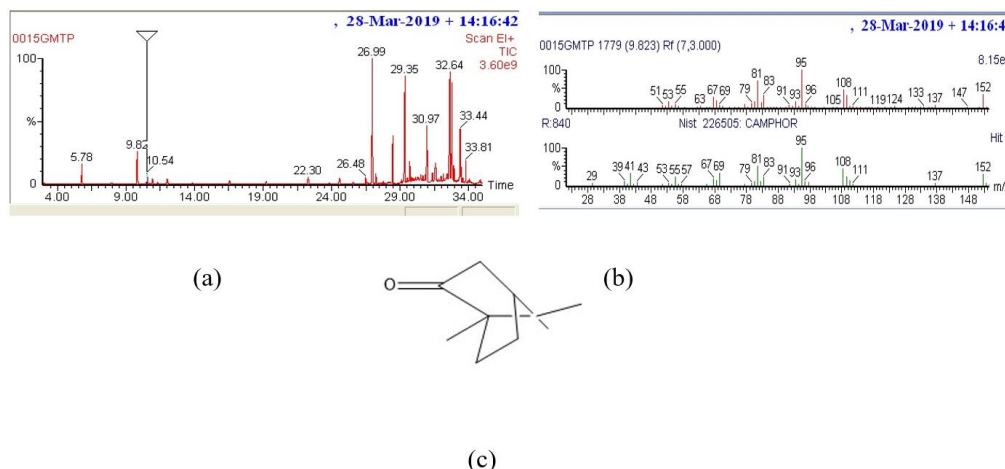


Figure 3. GC-MS chromatograms of camphor from the rhizome of *Curcuma caesia* according to (a) retention time and (b) mass to charge ratio (c) structure of Camphor

According to GC-MS chromatogram, the peak appears at the retention time 5.78 min with 100 % relative abundance. At this retention time, the GC-MS spectrum Figure 2 shows the molecular ion peak m/z 154, indicating the molecular weight of a compound to be 154 with the molecular formula $C_{10}H_{18}O$. Therefore, it can be referred that the compound is eucalyptol.

At this retention 9.82 min, the GC-MS spectrum Figure 3 shows the molecular ion peak m/z 152, indicating the molecular weight of a compound to be 152 with the molecular formula $C_{10}H_{18}O$. Therefore, it can be referred that the compound is camphor.

At this retention 10.54 min, the GC-MS spectrum Figure 4 shows the molecular ion peak m/z 154, indicating the molecular weight of a compound to be 154 with the molecular formula $C_{10}H_{18}O$. Therefore, it can be referred that the compound is *p*-menth-2-en-9-ol, trans.

At this retention 12 min, the GC-MS spectrum Figure 5 shows the molecular ion peak m/z 154, indicating the molecular weight of a compound to be 154 with the molecular formula $C_{10}H_{18}O$. Therefore, it can be referred that the compound is L- α -terpineol.

At this retention 22.3 min, the GC-MS spectrum Figure 6 shows the molecular ion peak m/z 204, indicating the molecular weight of a compound to be 204 with the molecular formula $C_{15}H_{24}$. Therefore, it can be referred that the compound is α -bulnesene.

At this retention 24.58 min, the GC-MS spectrum Figure 7 shows the molecular ion peak m/z 204, indicating the molecular weight of a compound to be 204 with the molecular formula $C_{15}H_{24}$. Therefore, it can be referred that the compound is isocaryophyllene.

At this retention 26.48 min, the GC-MS spectrum Figure 8 shows the molecular ion peak m/z 204, indicating the molecular weight of a compound to be 204 with the molecular formula $C_{15}H_{24}$. Therefore, it can be referred that the compound is gamma- muurolene.

At this retention 26.99 min, the GC-MS spectrum Figure 9 shows the molecular ion peak m/z 216, indicating the molecular weight of a compound to be 216 with the molecular formula $C_{15}H_{20}O$. Therefore, it can be referred that the compound is benzofuran, 6-ethenyl-4,5,6, 7-tetrahydro-3,6-dimethyl-5-isoprop.

At this retention 28.47 min, the GC-MS spectrum Figure 10 shows the molecular ion peak m/z 204, indicating the molecular weight of a compound to be 204 with the molecular formula $C_{15}H_{24}$. Therefore, it can be referred that the compound is gamma-elemene.

At this retention 30.97 min, the GC-MS spectrum Figure 11 shows the molecular ion peak m/z 218, indicating the molecular weight of a compound to be 218 with the molecular formula $C_{15}H_{22}O$. Therefore, it can be referred that the compound is beta-elemenone.

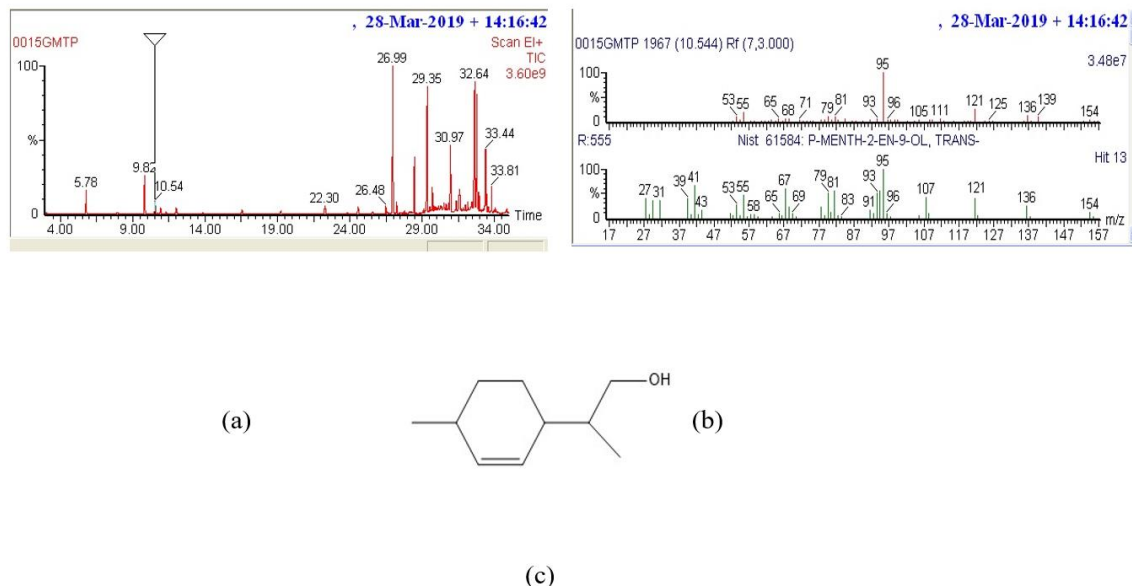


Figure 4. GC-MS chromatograms of *p*-menth-2-en-ol, trans from the rhizome of *Curcuma caesia* according to (a) retention time and (b) mass to charge ratio (c) structure of *p*-menth-2-en-ol, trans

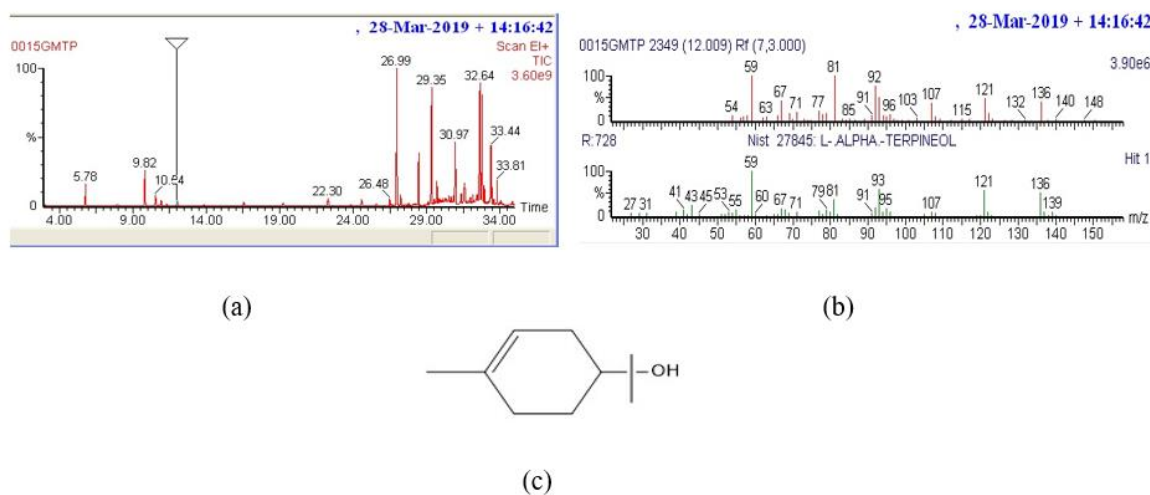


Figure 5. GC-MS chromatograms of L- α -terpineol from the rhizome of *Curcuma caesia* according to (a) retention time and (b) mass to charge ratio (c) structure of L- α -terpineol

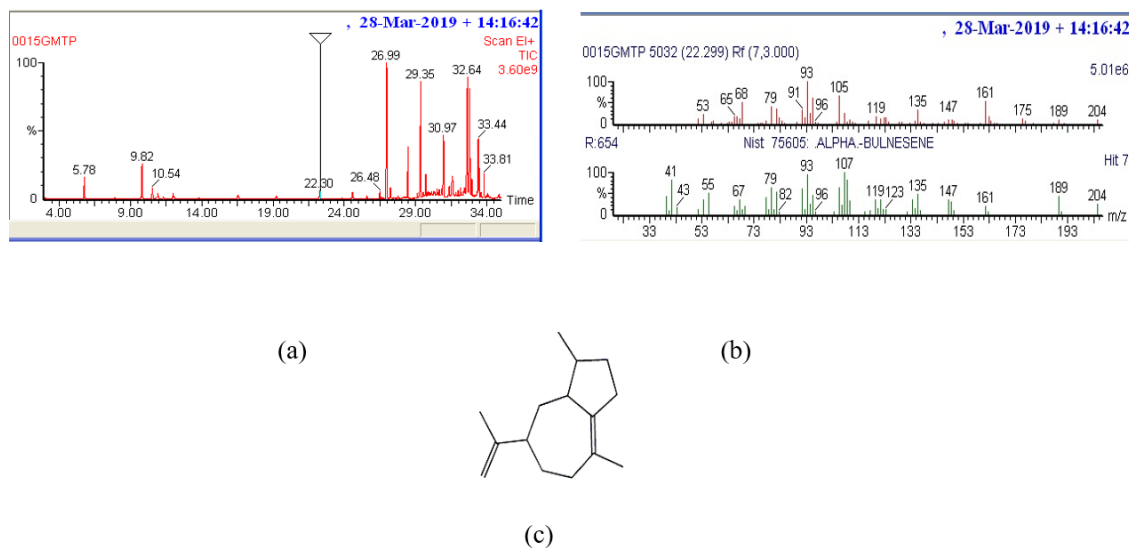


Figure 6. GC-MS chromatograms of alpha-bulnesene from the rhizome of *Curcuma caesia* Roxb. according to (a) retention time and (b) mass to charge ratio (c) structure of alpha-bulnesene

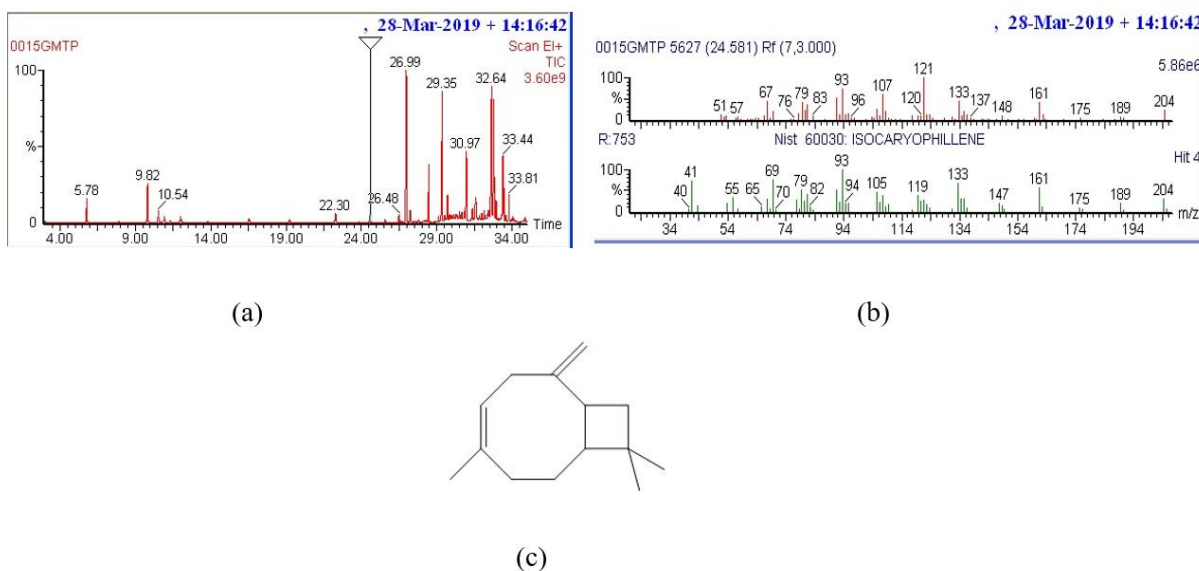


Figure 7. GC-MS chromatograms of isocaryophyllene from the rhizome of *Curcuma caesia* Roxb. according to (a) retention time and (b) mass to charge ratio (c) structure of isocaryophyllene

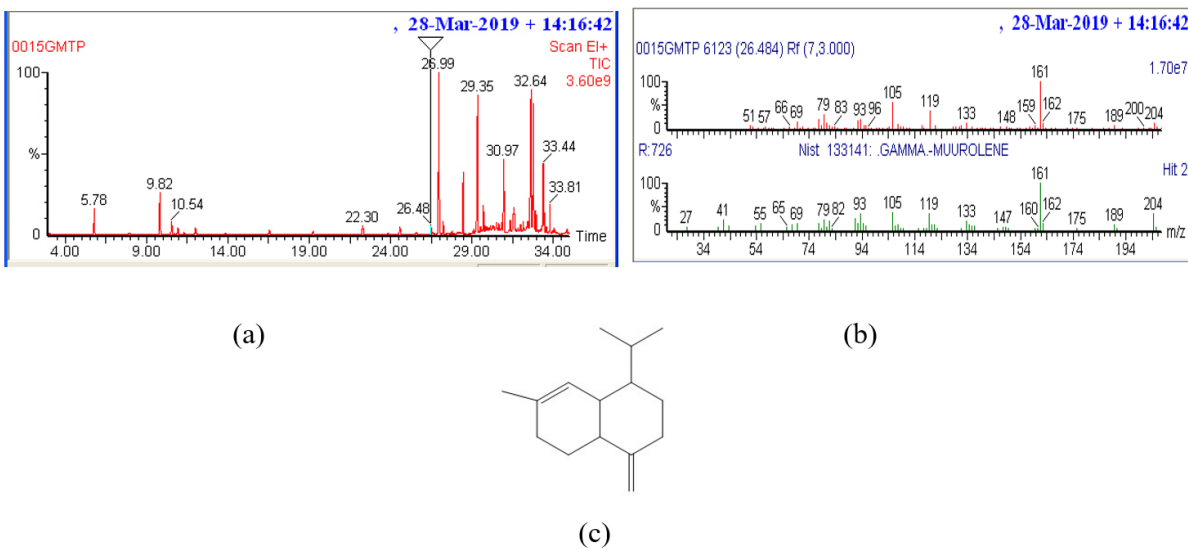


Figure 8. GC-MS chromatograms of gamma-murolene from the rhizome of *Curcuma caesia* Roxb. according to (a) retention time and (b) mass to charge ratio (c) structure of gamma-murolene

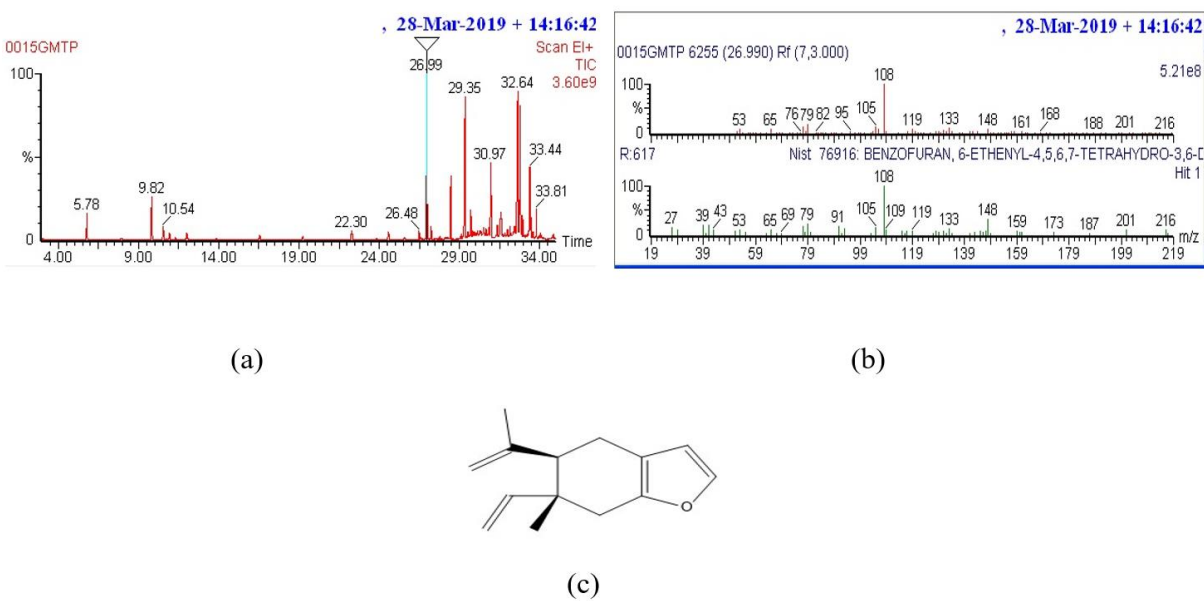


Figure 9. GC-MS chromatograms of Benzofuran, 6-ethenyl-4,5,6,7-tetrahydro-3,6-dimethyl-5-isopropyl *Curcuma caesia* Roxb. according to (a) retention time and (b) mass to charge ratio (c) structure of Benzofuran, 6-ethenyl-4,5,6,7-tetrahydro-3,6-dimethyl-5-isopropyl

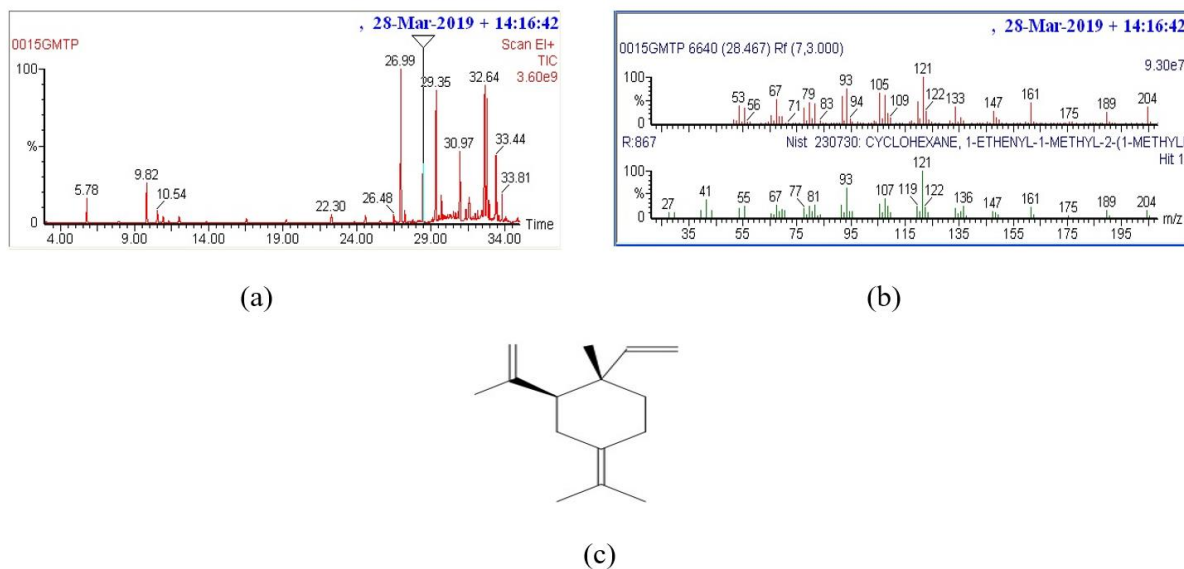


Figure 10. GC-MS chromatograms of gamma-elemene from the rhizome of *Curcuma caesia* Roxb. according to (a) retention time and (b) mass to charge ratio (c) structure of gamma elemene

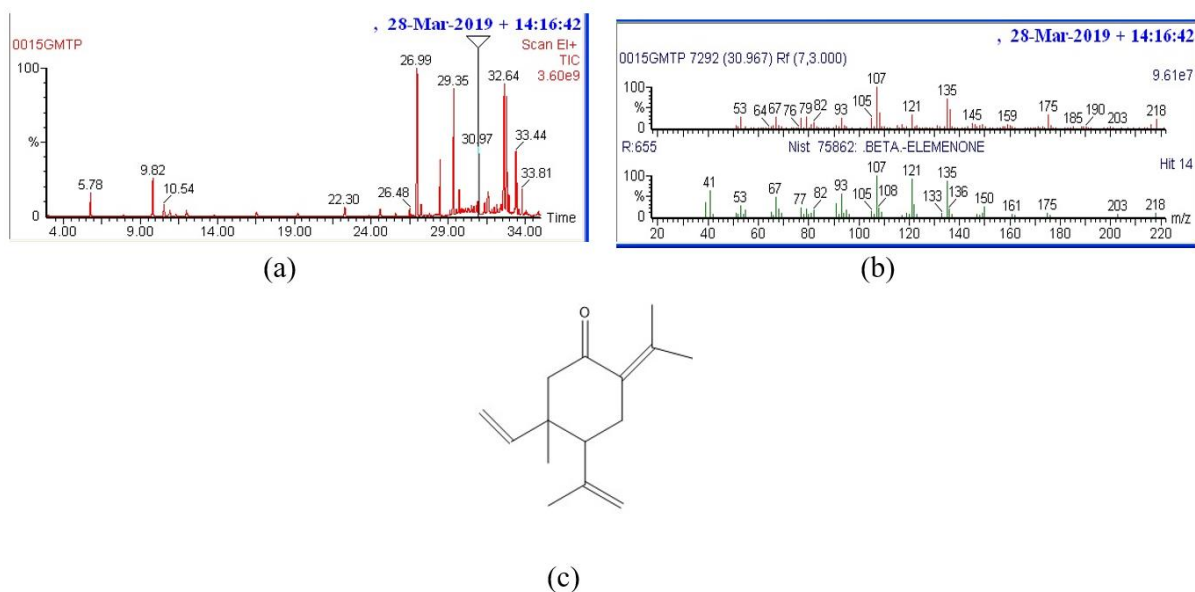


Figure 11. GC-MS chromatograms of beta-elemenone from the rhizome of *Curcuma caesia* Roxb. according to (a) retention time and (b) mass to charge ratio (c) structure of beta-elemenone

Conclusion

In this study, investigation of phytochemical constituents and the organic compounds from essential oil of *Curcuma caesia* Roxb. (Ga Mone Tain Pyar) were reported. The result of preliminary phytochemical screening of *Curcuma caesia* Roxb. (Ga Mone Tain Pyar) revealed the presence of alkaloids, amino-acids, carbohydrates, flavonoids, glycosides, organic acids, phenolic compounds, saponin, starch, tannins and terpenoids and the absence of cyanogenic glycosides, reducing sugars and steroids. The components of essential oil from *Curcuma caesia* were analyzed by GC-MS, which resulted in the identification of 10 components such as eucalyptol, camphor, L-alpha-terpineol, *p*-menth-2-en-9-ol, trans, alpha-bulnesene, isocaryophyllene, benzofuran, 6-ethyl-4-5-6-7-tetrahydro-3-6-dimethyl-5-isoprop, gamma-elemene and beta-elemenone. The essential oil is used in cosmetic and is also used for curing bronchitis, asthma, tuberculosis and spleen enlargement. The plant may be useful in the treatment of toothaches, treat skin, wound infections, relieve digestive problems and kidney disorders. In the traditional system of medicine, the fresh rhizome is applied in case of snake and scorpion bite.

Acknowledgements

First of all, we wish to express our deepest appreciation and special thanks to Rector Dr. Nay Win Oo, Pro-Rectors Dr Aye Aye Ko, Dr. Wah Wah Lwin, and Dr. Thidar Aung, East Yangon University for their kind permission to submit this paper. We would like to express our sincerest thanks to Dr Myo Myo Myat (Professor and Head), Dr Than Than Oo (Professor) and Dr Myint Myint May (Professor), Department of Chemistry, East Yangon University, for the encouragement and advice.

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INVESTIGATION ON SOME PHYTOCHEMICAL CONSTITUENTS AND ANTIMICROBIAL ACTIVITY OF LEAVES OF *PHYSALIS PERUVIANA* L. (HPAUNG-HPAUNG-THI)

Thein Htet Aung¹, Tet Tun², San San Myint³

Abstract

In this research, *Physalis peruviana* L. (Solanaceae family) known as hpaung-hpaung-thi in Myanmar has been chosen to perform some chemical analysis and biological activities investigation on its leaves. *Physalis peruviana* L. extracts were tested for different phytochemical constituents by preliminary qualitative chemical analysis. Some crude extracts were prepared with various solvents such as petroleum ether, ethanol, ethyl acetate and water. The yield percent of these extracts were 1.82, 13.14, 2.18 and 4.05 respectively. By using thin layer and column chromatographic separation technique, the isolated compound (0.0052 % yield, pale green powder form, m.pt = 201°C) was separated from ethyl acetate crude extract of leaves sample. In the study of FTIR spectrum of the isolated compound, the functional groups of the isolated compound were found to contain an unsaturation with lactone and hydroxy group. The antimicrobial activity of ethanol extract, water extract and isolated compound were screened by using Agar Well Diffusion method. From these results the antimicrobial activity of isolated compound was better than the two others.

Keywords: *Physalis peruviana* L., hpaung-hpaung-thi, antimicrobial activity, agar well diffusion method, FTIR spectrum

Introduction

Medicinal plants are an important part of our natural wealth. They serve as important therapeutic agents as well as valuable raw materials for manufacturing numerous traditional and modern medicines. The history of medicinal plants use for treating diseases and ailments is probably dates back to the beginning of human civilization. Our forefathers were compelled to use any natural substance that they could find to ease their suffering caused by acute and chronic illnesses, physical discomforts, wounds, and injuries, and even terminal illness. Since ancient times, plants with therapeutic properties have secured an important place in the healing practices and treatment of diseases. In many developed countries, traditional medicine is still the mainstay of health care, and most of the drugs and cures come from natural sources such as plants. (Motaleb, 2011).

Botanical aspects of *Physalis peruviana* L.

Materials and Methods

The leaves of *Physalis peruviana* L. (hpaung-hpaung-thi, HHT) were collected from Peinnegone Village in Kyaikmayaw Township, Mon State. *Physalis peruviana* L. (HHT) was identified by authorized lecture in the Department of Botany, Mawlamyine University. After being washed with water, the collected samples were dried at room temperature. The dried samples were cut into small pieces and ground into powder by a grinding machine. These powdered samples were stored in air-tight containers.

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Phytochemical Investigation of *Physalis peruviana* L. by Test Tube Method

The Preliminary phytochemical examination on different extracts of the HHT sample was performed by Test Tube Method according to the procedures as described by Harbone, 1984 and Tin Wa, 1972.

Botanical aspects of *Physalis peruviana* L.

Botanical name	- <i>Physalis peruviana</i> L
Family	- Solanaceae
Genus	- <i>Physalis</i>
Species	- <i>peruviana</i>
Myanmar name	- Hpaung-hpung-thi
English name	- cape gooseberry, goldenberry
Parts used	- Leaves



Figure 1. Phototraphy of Plant of *Physalis Peruviana* L.

Preparation of Various Crude Extracts from Leaves of *Physalis peruviana* L.

Procedure

The dried powdered sample was extracted with petroleum ether (PE) by Soxhlet extraction method to get concentrated petroleum crude extract. The marc was then extracted with 95% ethanol (EtOH). After filtration and concentration to one third of the original filtrate, the suspended 95% ethanol crude extract was partitioned between ethyl acetate (EtOAc) and distilled water. The ethyl acetate portion was separated. The extracts of ethyl acetate and water obtained were then concentrated by using rotatory evaporator and dried over steam bath. The resultant PE, 95% EtOH and EtOAc extracts were then stored and kept in the refrigerator to investigate the phytochemical constituents and for screening of bioactivity.

Isolation of Organic Compound From Leaves of *Physalis peruviana* L. by Column Chromatographic Separation Technique

Procedure

The column was packed with silica gel and petroleum ether. The solvent PE:EtOAc (20:1;v/v) system was chosen by TLC checking. The solvent was allowed to flow until a stable column is obtained. The EtOAc extract was mixed with a little amount of selected solvent system. The top of layer was wet with solvent. Gradient elution was performed successively with PE:EtOAc (20:1, 9:1, 4:1, 2:1, and 1:1, v/v) and only one main fraction was collected. The fraction was monitored by TLC. These crystals were purified by washing petroleum ether followed by PE : EtOAc, 9:1, and 4:1, v/v, and the fractionated compound was isolated.

Screening on Antimicrobial Activity of Ethanol Extract, Water Extract and Isolated compound

The antimicrobial activities of ethanol extract, water extract and isolated compound were investigated by using Agar Well Diffusion method. The agar plates containing test organisms were punched to make the wells (10 mm in diameter) using sterile cork borer and filled with the extract solution (40 μ L) and then these plates were incubated at room temperature for 24hrs. After incubated the diameter of the growth inhibition zones surrounding the wells were measured in mm. These zones indicated the presence of antimicrobial activities which inhibit the growth of test organisms selectively (Collins, 1965).

Results and Discussion

Phytochemical Constituents in *Physalis peruviana* L.

After preparing the sample, the phytochemical chemical studies of the HHT were carried out. The performed qualitative studies indicated the presence of various phytochemical constituents. The results of the phytochemical test were summarized in Table 1.

Table 1. Phytochemical Test Results of Leaves of *Physalis peruviana* L.

No.	Tests	Extracts	Test Reagent	Observation	Remark
1	Alkaloids	1% HCl	(i) Wagner's reagent (ii) Mayer's reagent	Reddish brown ppt White ppt	+ +
2	α - amino acids	H ₂ O	Ninhydrin reagent	Purple spot	+
3	Carbohydrates	H ₂ O	10% α -naphthol & conc:H ₂ SO ₄	Red ring	+
4	Cyanogenic glycosides	H ₂ O	Sodium picrate	No brick red colour	-
5	Flavonoids	EtOH	Magnesium turnings and conc : HCl	pink colour	+
6	Glycosides	H ₂ O	10% lead acetate	White ppt	+
7	Organic acids	H ₂ O	Bromocresol green Indicator	Yellow colour	+
8	Phenolic compounds	H ₂ O	1% FeCl ₃ & K ₃ Fe(CN) ₆	No Deep blue Colour	-
9	Protein	H ₂ O	10%NaOH solution and 0.7% CuSO ₄ solution	No Violet colour	-
10	Reducing sugars	H ₂ O	Benedict solution	No Brick-red ppt	-
11	Saponins	H ₂ O	Distilled water	Frothing	+
12	Starch	H ₂ O	1% Iodine solution	Blue colour	-
13	Steroids	EtOH	Acetic anhydride and conc:H ₂ SO ₄	Green	+
14	Tannins	EtOH	Ethanolic solution of FeCl ₃	No Green colour	-
15	Terpenoids	CHCl ₃	Acetic anhydride, conc:H ₂ SO ₄	No Red colour	-

(+) = presence, (-) = absence, ppt = precipitate

Preparation of Various Crude Extracts from Leaves of *Physalis peruviana* L.(HHT)

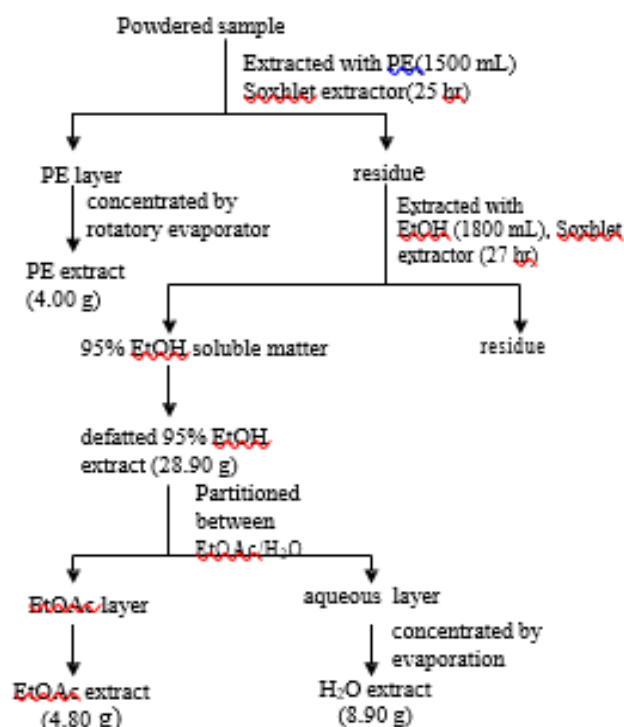


Figure 2. Flow diagram for the preparation of various crude extracts from leaves of *Physalis peruviana* L.

Isolated Compound from EtOAc Crude Extract

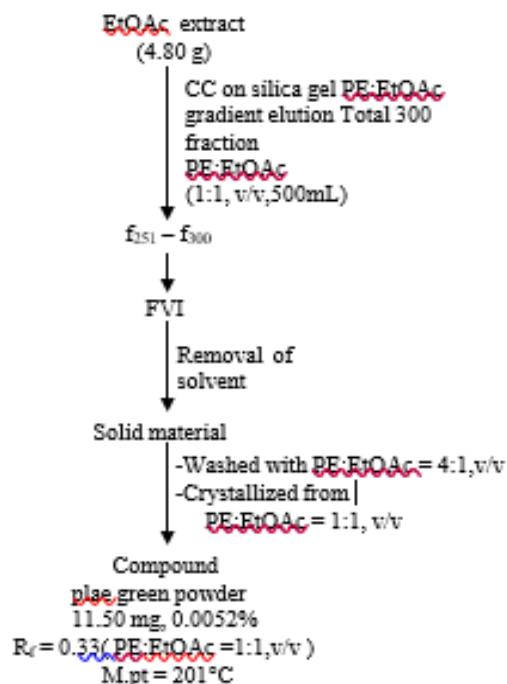
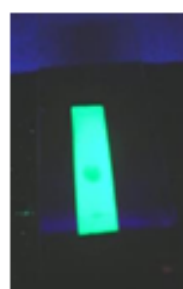


Figure 3. Procedure for the separation of EtOAc crude extract from leaves of *Physalis peruviana* L. by column chromatography

Isolated compound and TLC chromatogram



Figure 4. Photograph of isolated compound



Under UV 254 nm
(pale brown colour)
 $R_f = 0.33$
Solvent system =
PE : EtOAc 1:1

Figure 5. TLC chromatogram of isolated compound

Some Physico-chemical Characteristics of Isolated Compound

Physicochemical characteristic of isolated compound were studied by the determination of their R_f value, melting point, solubilities in various solvents and by some chemical tests involving 1% FeCl_3 , Mg/HCl , Liebermann-Burchard reagent, 5% H_2SO_4 , anisaldehyde- H_2SO_4 and Vanillin- H_2SO_4 tests. The results obtained were reported in Tables 2 and 3.

Table 2. Some Physical Properties of Isolated Compound

Physical properties	Observation
PE	-
EtOAc	+
EtOH	+
Solubility in MeOH	-
CHCl ₃	+
H ₂ O	-
R _f value	0.33 (PE:EtOAc = 1:1 v/v)
Physical state	Pale green powder
Yield (%)	0.0052%
Melting point	201°C

(+) = soluble, (-) = insoluble,

Table 3. Some Chemical Properties of Isolated Compound

Test reagents	Observations	Remark
1% FeCl ₃	No colouration	Not a phenolic compound
Vanillin – H ₂ SO ₄	Violet colouration	a steroid and higher alcohols
5% H ₂ SO ₄	Pale yellow colouration	a steroid and lactone
Bromocresol green	No Blue colouration	Not an organic acid
Liebermann-Burchard	Yellowish green Colouration	a steroid

Interpretation of FTIR Spectrum of Isolated Compound

The isolated compound was analyzed by FTIR and it was observed that the presence of the following functional groups. The FTIR spectrum of the isolated compound was shown in Figure 6 and its spectral data was recorded in Table 4. From FTIR data, the isolated compound was unsaturated compound with γ – lactone and hydroxy group.

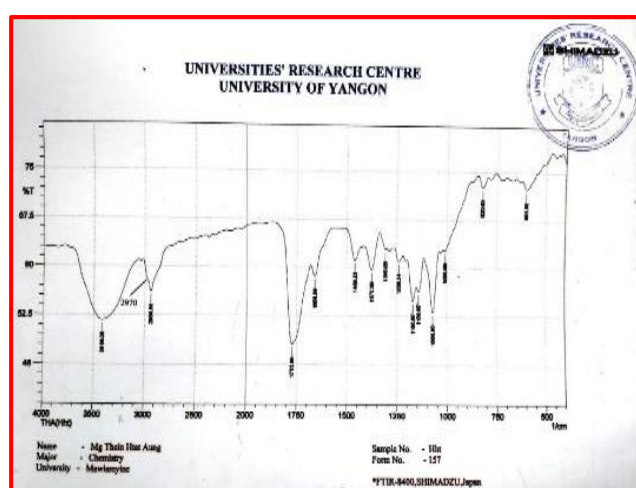
**Figure 6. FTIR spectrum of isolated compound**

Table 4 . FTIR Spectral Data of Isolated Compound

Frequencies (cm ⁻¹)	*Assignment
3416	$\nu_{\text{O-H}}$ (alcohol)
2970	$\nu_{\text{C-H}}$ in -CH ₃ groups (antisymmetric)
2939	$\nu_{\text{C-H}}$ in -CH ₃ groups (symmetric)
1772	$\nu_{\text{C=O}}$ (γ -lactone)
1658	$\nu_{\text{C=C}}$ (olefin)
1456	$\delta_{\text{C-H}}$ in -CH ₃ groups (antisymmetric)
1373	$\delta_{\text{C-H}}$ in -CH ₃ groups (symmetric)
1236, 1166	$\nu_{\text{C-O-C}}$ (in lactone)
1139, 1066	$\nu_{\text{C-O}}$ (alcohol)

*(Bellamy, 1958; Flett, 1963)

Antimicrobial Activity of Leaves of *Physalis peruviana* L.

The antimicrobial activity of ethanol extract, water extract and isolated compound of *Physalis peruviana* L. was screened by Agar Well Diffusion method. The test organisms used were *Bacillus subtilis*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Bacillus pumilus*, *Candida albicans* and *Escherichia coli*. The results were shown in Table 5, Figures 7 and 6. According to the inhibition zone diameters, isolated compound showed the highest activity and water extract showed the lowest activity.

Table 5 Inhibition Zone Diameters for Isolated Compound Ethanol Extract and Water Extract of Leaves of *Physalis peruviana* L. against Six Species of Microorganisms

Extracts	Organisms and inhibition zone diameters (mm)					
	<i>B.subtilis</i>	<i>S.aureus</i>	<i>P.aeruginosa</i>	<i>B.pumilus</i>	<i>C.albicans</i>	<i>E.coli</i>
EtOH	13	16	18	15	14	15
H ₂ O	11	12	12	12	-	-
Isolated compound	22	20	23	22	20	22

Agar Well Diameter – 10 mm

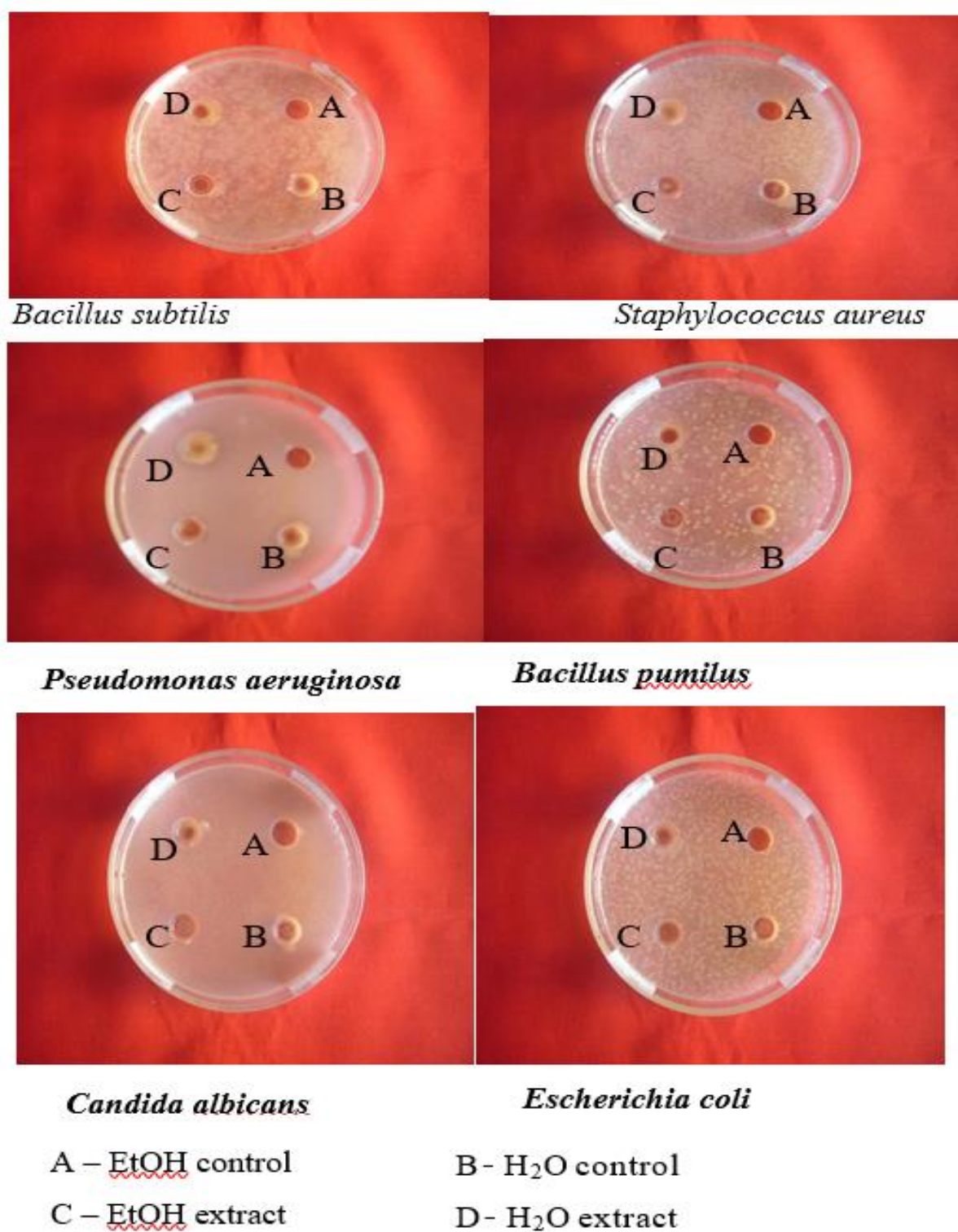


Figure 7. Inhibition zone diameters for EtOH extract and water extract of leaves of HHT against six species of microorganisms

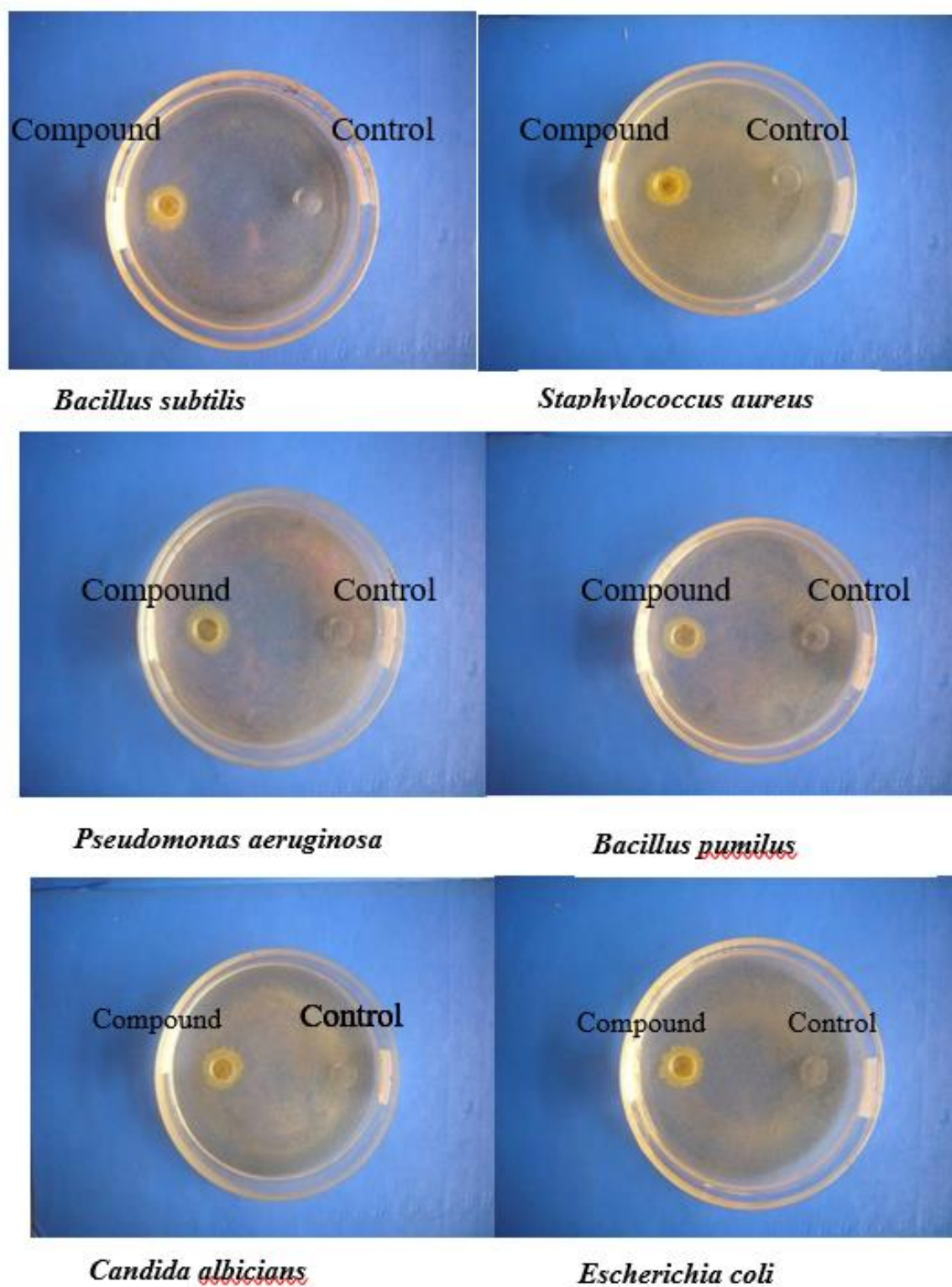


Figure 8. Inhibition zone diameters for isolated compound from EtOAc crude extract of leaves of HHT against six species of microorganisms

Conclusion

From the present research work the following inferences could be drawn. Based on the phytochemical test results, alkaloids, α -amino acids, carbohydrates, flavonoids, glycosides, organic acids, saponins and steroids were present in the selected medicinal plant. Some crude extracts were prepared with various solvent such as petroleum ether (PE), ethanol (EtOH), ethyl acetate (EtOAc) and water. The yield percent of these extracts were 1.82, 13.14, 2.18 and 4.05 respectively. By using thin layer and column chromatographic separation technique, only steroid compound (0.0052 % yield, pale green powder form, M.pt = 201°C) was isolated from EtOAc crude extract of leaves of HHT. From FTIR spectral results, the functional groups present in isolated compound were an unsaturation with γ - lactone and hydroxy group. According physicochemical examination and FTIR spectral data the isolated compound may be a steroid compound. From the investigation of the antimicrobial activity, it was found that ethanol extract was against six species of microorganisms such as *Bacillus subtilis*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Bacillus pumilus*, *Candida albicans* and *Escherichia coli* but water extract was against only for organisms except *Candida albicans* and *Escherichia coli*. The isolated compound was found to possess more potent antimicrobial activity than the two other extracts. Therefore, it could be concluded that the leaves of HHT may be used for the treatment of the diseases related to six microorganisms described above. Especially, the isolated compound from the leaves of HHT may be used as an antimicrobial agent.

Acknowledgements

We would like to our express thanks to Rector Dr Nay Win Oo, Pro-Rectors Dr Aye Aye Ko, Dr Wah Wah Lwin and Dr Thida Aung, East Yangon University, for their permission to submit this research paper. We also express the special thanks to Dr Myo Myo Myat (Professor and Head), Dr Than Than Oo and Dr Myint Myint May (Professors), Department of Chemistry, East Yangon University, for their kindly encouragement and supporting on writing this paper.

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